PVA Biology Work Group Meeting
May 14th, 15th and 16th, 2012
US Bureau of Reclamation
555 Broadway Blvd. NE, Albuquerque, NM 87102

May 2012 Actions

- Yvette Paroz will determine if the ASIR population monitoring data provided already includes depth/velocity/temperature/etc. information. (*from 05/16/12)*
- Yvette Paroz will check the ASIR data to determine if the mesohabitat/surficial area is in GIS or electronic file formats. (*from 05/16/12)*
- Jason Remshardt will email the FWS Population Monitoring data with mesohabitat/depth/velocity/substraight information (1999 to 2001; 2002-2012) to Dr. Goodman and copy Yvette Paroz for posting to the Program's website. (*from 05/16/12)*
- Yvette Paroz will provide Dr. Goodman with Reclamation's Fish Datasets that include information on depth/velocity/substraight; these datasets will also be posted to the Program's website. (*from 05/16/12)*
- Dr. Goodman will compare the Program website to his for discrepancies and will email any missing files (ex. the Dudley data file) to Yvette Paroz for posting to the Program website. (*from 05/16/12)*
- ✓ Yvette Paroz will provide ASIR's Population Monitoring and Population Estimation presentation to the ScW work group to Tetra Tech to distribute to the PVA work group. (*from 05/16/12; Tt emailed to Ali to post on 05/22/12)*
- Peter Wilkinson will follow up with Grace Haggerty on her action (from December 2011) to forward the Doug Wolf "I40 to Central Inundation" Presentation to Mick Porter. (*from 05/16/12)*
- Rich Valdez will send his temperature/minnow length (hatch & growth rate) work to Mick Porter. (*from 05/16/12)*
- Comments, considerations, suggestions, and other feedback on the Corps' Cochiti Deviation Analysis should be emailed directly to Mick Porter as soon (and as often) as possible. (*from 05/16/12)*
- PVA work group members will review the datasets on Dr. Goodman's website to prepare discussion points, questions, and identification of anything that needs validation or review in preparation for the Consensus Dataset decision at the June 11th meeting. Feedback should be emailed to David Gensler and Dr. Goodman no later than May 31st, 2012 in order for a simple yes/no decision to occur at the June meeting. If no comment is received by then, members risk losing their ability to provide input into the process. (*from 05/16/12)*

Ongoing/Continued Action Items

- The PVA modelers (D. Goodman and P. Miller) will provide the co-chairs a list of their needs and requirements necessary to have functional models by the June 30th, 2012 deadline. The work group will use these lists to develop a schedule. (*from 12/12/11)*
- Dr. Goodman will provide a document describing the process(es) used in the formation of the datasets (ex. merging of the population monitoring data to achieve a single, master dataset) for the actual consensus agreement discussion in the next PVA meeting. (*from 12/12/11)*
- Rich Valdez to send the side-by-side comparison of ASIR datasets to Yvette Paroz to help facility the conversations and resolution with ASIR. (*from 12/12/11)*
- Stacey Kopitsch will elevate the PVA request to be put on the April EC agenda for discussion pertaining to: (1) development of the PVAs in relationship to the BAs and BO(s); (2) comparison (similarities and differences) between the models that could influence output differences. (*from 12/12/11)*
- Stacey Kopitsch will elevate the PVA request that the EC members provide a list of questions that they would like the PVA modelers to respond and/or present on during the April EC meeting. (*from 12/12/11)*

- In preparation for the next PVA meeting decision on the consensus data, all PVA members are encouraged to visit Dr. Goodman's website and review the RGSM data sections in order to be informed and knowledgeable about the datasets that are up for approval. (*from 12/12/11)*
- Jason Remshardt and Mick Porter will provide electronic copies of the river channel resetting studies done for Big Bend, Texas. (*from 12/12/11)*
- Alison Hutson and Mick Porter will talk with Jericho Lewis about how to transfer collected minnows (samples) so they can be provided as government supplied materials and thus allow for easier extended study and research (as opposed to limited to the contract requirements). (*from 12/12/11)*
- Rich Valdez will put together a strawman on existing information on the fish/flow relationships to get a running accounting of the information out there; he will send the draft strawman to Mick Porter for feedback. (*from 12/12/11)*
- Mick Porter will summarize site complexity standardization literature in relationship to the Middle Rio Grande. (*from 12/12/11)*

Suggestions/Recommendations

- It was suggested that the PVA work group consider a formal renewal of the data requests (ex. by-seine haul data for fish by mesohabitat) in order to make sure the requests have not been forgotten. Any newly identified datasets could be added to this formal request as well.
- It was suggested that the modelers address the Service's questions with responses that specify the information or data that would need to be provided as input in order to get outputs/answers from the model. It was also suggested that the modelers could include an estimated timeline for answers once said data has been made available.
- It was suggested that the modelers could provide the following by the June 15th deadline: (1) a "quasi-strawman" test run(s) using the existing 10-year scenarios; and (2) produce a memo or statement highlighting what appears to be the most significant conclusion or sensitive species response based on all the analysis, discussions, and experience of the models to date.

Next Steps: between now and the June 11th meeting

- PVA members will read and "digest" Dr. Goodman's *RGSM 2010 Revised Recovery Criteria in Relation to Population Monitoring Draft Report* dated May 1st, 2012 in preparation for discussion at the June 11th meeting;
- The modelers will set up "quasi-strawman" PVA models to see how well the current platform f(with acknowledged limitations and restrictions) might help to provide some initial/draft outputs to the action agencies by the June 15th deadline;
- PVA work group members will review the datasets on Dr. Goodman's website to prepare discussion points, questions, and identification of anything that needs validation or review in preparation for the Consensus Dataset decision at the June 11th meeting. Feedback should be emailed to David Gensler and Dr. Goodman no later than May 31st, 2012 in order for a simple yes/no decision to occur at the June meeting;
- The modelers will prepare a memo to address each Service question and identify what information/data would be needed in order for the PVA models to provide good responses.

Meeting Summary

DAY 1: Monday, May 14th (afternoon)

- Dave Gensler brought the meeting to order. In a "pre-meeting" meeting, attendees reviewed and discussed the Executive Committee (EC) questions and requests in preparation for Tuesday's PVA presentations.
    - Meeting attendees reviewed proposed answers developed by Dr. Goodman for the EC questions. Meeting attendees were able to agree on consensus answers to the questions developed by MRGCD and NMDA and that Dr. Miller would brief the EC on the PVA's

ability to address the Service's questions. Attendees agreed that the answers should be read by Reese Fullerton and presented as a consensus document from the PVA work group.

- Attendees discussed Tuesday's PVA presentation to the EC and agreed that it would be more appropriate to have a roundtable discussion as opposed to actual presentations. Dr. Goodman incorporated the edits made during Monday's discussion and distributed the revised document to Reese Fullerton (EC facilitator) and the PVA work group.

DAY 2: Tuesday, May 15th (morning)

- Lori Robertson (acting Federal Co-Chair) brought the meeting to order. Meeting attendees were given a brief update on yesterday's PVA work group session.
- Meeting attendees then discussed the addition of edits to the PVA document answering EC member questions that had not been incorporated into the revised version. Attendees were able to reach consensus on the addition of the edits and Lori Robertson made the edits to be document to be distributed during the EC meeting.
- Meeting attendees were then invited to join the Science (ScW) work group meeting until the EC presentations scheduled for 12:00 pm.

DAY 2: Tuesday, May 15th (afternoon)

- David Gensler brought the meeting to order. The discussion opened with review of the EC directive that was provided earlier in the afternoon. Attendees discussed the modeler's contractual obligations (including trainings) and the upcoming deadlines and schedules.
  - May 15 EC Directives:
    - The EC directed the PVA work group to determine during the remaining May meeting time, what could be accomplished by June 15th in order to inform Reclamation's draft BA including the possibility of modeling the baseline and proposed action(s) scenarios. The PVA work group was tasked to meet in early June in order to (1) review and discuss (internal review of) Dr. Goodman's *RGSM 2010 Revised Recovery Criteria in Relation to Population Monitoring Draft Report* dated May 1st, 2012 and (2) discuss and resolve the incorporation of hydrology/hydrologic scenarios into the PVA models. The PVA work group should also determine what can be accomplished by the Service's August 15th, 2012 information deadline and meet as often as necessary to accomplish this; additional PVA briefs to EC will also be scheduled.
- David Gensler then presented hydrology information that Reclamation submitted as part of their May 7th Draft Biological Assessment (BA) to the Service. Reclamation currently has 1 50-year sequence derived by "stringing" together 5 10-year exceedance scenarios that was generated through URGWOM and the PHVA process. This single 50-year hydrology sequence was run through URGWOM for a "no action" scenario and for the "proposed action" scenario. David explained that he post-processed the information taken from the Draft BA to attempt to arrive at hydrologic information that would be useable in/for the PVA modeling process.
  - For the "no action" scenario, the "optional" water operations are "turned off" - for example, the Districts storage and release. It was pointed out that "no action" does not mean "no management." All preexisting operations would remain in place.
  - Dr. Miller explained that, unfortunately, this type of information was not helpful for the RAMAS PVA model. The RAMAS model uses a flow-transformed-fecundity; in other words, a set of flows over a 50-year period are transformed into a fecundity factor that the model can apply survival rates and spawning conditions year to year over a certain period. The RAMAS model needs a functional relationship between flow and fecundity (flow x = fecundity y) that can be applied over a 50-year period.
  - Attendees then discussed the concern that the models are being offered 1 50-year water scenario out of infinite possibilities. This is not enough to be able to distinguish the "signal from the noise" or determine significant differences in the hydrograph - which means it is not possible to model the biological impact on the fish. It will be very hard (and impossible to defend) for the PVA models to be able to resolve any differences between a "no action" and

"proposed action" hydrologic scenario for the fish since there is no indication of the error or uncertainty around either. Any "difference" could be attributed to noise in the system or within range of acceptable variable. It is too small a sample size to draw any conclusions about the frequency of the event.

- The only way to get "realistic" information is to run many more simulations (tests) in order to have the "luck" or "noise" cancel out.
- Error bars to document the variability and uncertainty are crucial. If the error bars are small enough and do not overlap (between the no action and the proposed action), then some general conclusions can be made. But if the error bars overlap, there is no statistical difference.

- Participants then discussed the urgent need to resolve the hydrology component issue. Concern and frustration was expressed that the PVA work group cannot effectively move forward (in terms of productivity) until the appropriate information is provided.

DAY 3: Wednesday, May 16th, 2012 (all day)

- David Gensler opened the meeting. In a very brief agenda review, it was proposed that the December 2011 Action Item Review be postponed; however, attendees ended up reviewing the last half of the December action items anyway.
  - During the action item review, attendees discussed the importance of understanding the mesohabitat units available at different flow levels and the corresponding life-history support each provides for the minnow. The classification, quantification, and understanding of mesohabitat are important steps to understanding minnow needs.
    - Attendees also discussed the known mesohabitat datasets and information. Fish information by mesohabitat type can inform an index of abundance by mesohabitat. Understanding the mesohabitat availability (surficial mapping and/or aerial determination) will thus inform a fish to flow to habitat relationship.
    - The Service has fish data that includes mesohabitat and depth/velocity/substraight information. This dataset is probably bigger and more complete than the information requested from ASIR. It was suggested that this dataset could be used for an analysis now instead of waiting indefinitely on the requisition of the ASIR data.
    - Attendees briefly discussed that overall, the flow to mesohabitat relationships tend to be fairly stable over time. However, there are 3 places that have experienced change in the last 10 years: (1) Isleta – experienced sediment influx and filling of bars in 2005; (2) armoring of the channel from Cochiti to Perales/Alameda; and (3) the head cut from Elephant Butte to the Refuge.
- Attendees then completed a quick agenda review to adjust discussions as appropriate for the time remaining. Three priority discussions were identified: (1) Consensus data set agreement; (2) Resolve discussion on the hydrology concerns with a Reclamation representative present; (3) Consultation Updates and PVA relationship to the a) Recovery Implementation Program (RIP) Transition, b) Sufficient Progress Criteria, etc. Due to travel arrangements, both Dr. Miller and Dr. Goodman had to leave by 3:30pm.

- Mick Porter then presented on the Cochiti Deviation. The purpose of the deviation is to provide temporary retention and release of spring runoff flows for fish recruitment and overbanking flows through the Middle Rio Grande (MRG) valley to enhance the natural peak. The targets are: 3,000 cfs for 7 to10 days for a recruitment event and 5,800 cfs for 5 days for an overbanking event. This year, a 2-year extension to the initial 3-year deviation was requested and received. Unfortunately, it was determined in early April that the natural flows would not be enough to augment for a successful event so there was no deviation.
  - Mick Porter then shared that the Cochiti Deviation was part of a 5-year study to understand environmental flow for recruitment and to inform adaptive management for the minnow. At the end of the 5 years, a decision needs to be made on whether or not to request permanent

changes to the water control manual process. Any changes have to be justified to the Corps' change of command and then to congress as well. Rigorous analysis needs to be done – to determine what is or is not working, what can be made better, is the deviation meeting the needs of the minnow or not, etc.

- There are 3 main things that need to be understood: habitat requirements for recruitment, flow magnitude, and flow duration. The combination of magnitude and duration creates the minnow habitat.
- Annually quantifying the estimated inundated habitat (in acres per mile) as a function of flow peaks will be very informative. Below 3,000 cfs there is a recognized decreasing amount of habitat for larval fish. However, the "break points" on production of a certain number of fish are not yet known. It is hoped this analysis will provide information on the thresholds and the minimum flow level needed to produce inundated habitat (and for how long).
- In the initial analysis, it was shared that the Catch Per Unit Effort (CPUE) trend data was converted into a slope (a line fitted between the 2 points) in order to compare the general trend changes year to year and test the hypothesis that changes between the May and July samples will be significantly greater for years with a deviation.

- Returning to the hydrology/hydrologic inputs for the PVA, participants provided background information on the discussion from the Tuesday session.
  - The PVA work group has never received the appropriate hydrologic scenarios that are needed. Right now, based on the content of the recent Draft BA, there are 5 10-year scenarios that were "strung together" to reach a single 50-year scenario that was run through URGWOM for a "no action" and "proposed action." Unfortunately, with only 2 scenarios, it will be very difficult to understand the "realism" or lack thereof of stringing sequences together to get to 50 years and the statistical and biologic issues that arise. The work group is still trying to wrestle with that and how to fit such scenarios into the PVA in such a way that the outputs would be realistic projections of the biologic importance of the sequences to the fish. Also, it is impossible to describe any differences between the "no action" and "proposed action" since there is such a small sample size and no error bars. In other words, there appears to be little or no statistical difference between the two and without error bars there is no way to statistically distinguish them. This means that there would be no way to distinguish any PVA outputs in terms of fish response either.
  - More importantly, the PVA work group cautioned Reclamation that the Service is likely to reach a similar conclusion about the hydrology scenarios in their analysis – without error bars, any potential difference between the 2 can be attributed to a result of "noise" so they are basically the same.
    - Attendees then discussed possible options for resolving the hydrologic component issue:
      - Revisit/resurrect Jesse Roach's monthly time-step model – unfortunately, this model was overly simplistic as it did not contain all the operational rules and the work group determined a daily time-step was preferable;
      - PVA to use the original dataset to generate whatever they need – this option was disregarded because the work group does not/will not have the information on the variability between the runs;
      - PVA to use all the runs to generate whatever they need – the work group could do their own calculations of the statistical significance between the 2 hydrology scenarios but it was cautioned that the biologists would then be doing the hydrologists and Reclamation's work and time spend to do this would result in other tasks not getting done;
      - Return to the paleo data and completely redo the hydrologic reconstruction to address the statistical issues from the beginning – there is not enough time;

the work group would have to sacrifice other tasks and there are strict deadlines looming;

- PVA to take the existing runs drawn and run a bootstrap – but everything would still have to be rerun through URGWOM
- Look at the last 100-year record and do a selective randomization of the data and superimpose the no action/proposed action onto that – unfortunately, there is not realistic since major changes affecting the hydrology occur at regular intervals (~20 year on average). The world today doesn't look like it did 100 years ago and the proposed actions have to be framed in terms of today.

- It was pointed out that at this time, with the limitations of deadlines, the more severe problem is the absence of replication; the shortness of the sequences is problematic but the absence of replication is even more critical. To that end, the PVA work group requested that Reclamation select 5 sequences for each of the exceedance probabilities (10%, 30%, 50%, 70%, 90%) and run those through URGWOM for an additional 25 hydrologic scenarios. (In other words, instead of having a single 10% exceedance example, select the 5 sequences closest to 10%/30%/50%/70%/90% and run all through URGWOM). This exercise will help to address the variance issue and determine the sample variation within a stratum.
  - If 5 runs for each exceedance cannot be accomplished within the month (by approximately June15th), Reclamation was asked to determine how many could be completed. Even 2 additional runs per exceedance would provide an estimate of variance – which will be big but it could be used.

- PVA members discussed the resolution of the Consensus Data Set for this iteration of the PVA models. It was recommended that the work group consider and approve the data that are archived on Dr. Goodman's website. The documentation, quality control, and pedigree are all there. In response, it was cautioned that the originators of the data need to be active in the process and "sign off" on the data being used. Unfortunately, the process cannot be held up waiting for contractors to participate. As a compromise, it was offered that the work group make their decisions with the appropriate caveats.
  - Suggested ideas and language included:
    - *…The PVA work group accepts this data/these datasets with the acknowledgement that the originators did not contribute feedback or approval even though multiple opportunities to contribute and provide feedback and/or agreement on the datasets were offered.*
    - *The PVA work group is in agreement with using this data/these datasets that have been provided to date (most current). The background, collection methodologies, and intended use of the data has been thoroughly explained to the group and there is agreement with using these data sets as the consensus data for use in the PVA models for this iteration.*
    - *The PVA work group accepts the population monitoring data as provided by the originators to Dr. Goodman and as reconciled by Dr. Goodman. The datasets and the pedigree are shown and documented on Dr. Goodman's website. The PVA work group requests the originators of the data review and concur with the validation or reconciliation of the population monitoring data.*

- After lunch, the Service provided a brief update on the status of the ESA consultation and Patrick Redmond discussed the potential role of the RIP in the consultation and the potential roles of the PVA models.
  - The Service received the Corps' Draft BA in October 2011 and they responded by November 2011. However there are differences with the Corps that have no current path to resolution.

Reclamation's incomplete Draft BA was received on May 7th, 2012. Additional feedback and communication will be provided in the next few weeks. The formal consultation process does not begin until the Draft BAs are considered complete. It is expected that Reclamation will submit another rendition, hopefully complete, by July 31st, 2012. Once the formal consultation begins, the Service will provide a Draft Biological Opinion to the action agencies. It will be up to them to distribute for Program review. The Service will then proceed with a revision period and issue a Final BO before the 2003 BO terminates on March 1st, 2013.

- How the PVA will or will not inform the consultation remains to be seen. The original intent of the PVA models was 3-fold as outlined in the charter: (1) to support the BA/BO process; (2) support the adaptive management process; and (3) support the long-term recovery efforts. Any information provided by the PVA to Reclamation by June 15th could potentially be considered in the revised Draft BA. Any information provided by the PVA to the Service by August 15th could potentially be considered for use in the Draft BO.

- At the August 2009 EC Taos Retreat, the executives agreed that by taking a recovery path, the entities in Program would have a more stable, predictable path forward toward eventual down- and delisting. The place of the Recovery Implementation Program (RIP) in the Collaborative Program as a whole is: (1) to provide the federal nexus allowing Reclamation to recruit all the other EC entities into this consultation and thus allowing the non-federal partners to be covered in the Section 7 consultation; (2) it becomes the governance body to administer and fund (or receive funding) for actions to promote recovery; and (3) it is designed as the conservation measure which sufficiently minimizes the impacts of actions on the species so the Service can issue a no jeopardy opinion. The RIP is the mechanism for committing the entities to perform certain activities that they have agreed to and the Service has concurred.
  - Attendees then discussed the sufficient progress metrics that will be the basis of the annual review of the RIP and how the PVA models fit into the development or recommendations for sufficient progress metrics.
  - PVA model outputs can be used to propose and validate indicators of progress (ex. evaluate whether or not hatchery releases are a good indicator of survival probability) and to even develop the sufficient progress metrics. PVA models can also inform the data collection and methodologies that need to be modified in order to be more appropriate or useful.
  - The PVA can also be run annually (updated with that year's data) to provide assurances to the Service that the species/system is doing fine. This yearly PVA output could indicate where the system "moved" relative to extinction risk and it can indicate if the species moved closer or farther from the recovery criteria. It can also indicate the probability of achieving expected recovery in a certain timeframe.

Next Meeting: Monday, June 11th from 9:00am to 4:00pm and Tuesday, June 12th from 9:00am to 4:00pm; location TBD

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May 14th, 15th, and 16th, 2012
US Bureau of Reclamation
555 Broadway Blvd. NE, Albuquerque, NM 87102
Rio Grande Conference Room

Meeting Notes

DAY 1: Monday, May 14th, 2012 – EC Questions Review and Discussion (afternoon)

- Dave Gensler brought the meeting to order. In a "pre-meeting" meeting, attendees discussed the Executive Committee (EC) questions and requests in preparation for Tuesday's PVA presentations. The purpose of the meeting is to come to agreement on answers to the questions and develop a strategy to have a logical and seamless presentation so that the modelers can focus on answering any further questions the EC may have.
    - Meeting attendees were reminded that the EC was asked to provide questions for the modelers to address during their presentations. Three sets of questions have been received, one from the Middle Rio Grande Conservancy District (MRGCD), one from the New Mexico Department of Agriculture (NMDA), and one from the U.S. Fish and Wildlife Service (Service).
    - Dr. Goodman distributed a hand out of his proposed answers to the MRGCD and NMDA questions.
        - The modelers may be able to answer the Service's questions to a certain extent depending on what the Service wants to get out of the questions in the context of Tuesday's presentation. Though the specific answers to the questions may not be known the modelers could go through the questions at a basic level and explain how the individual models structures are prepared to answer each question.
        - Meeting attendees discussed what is expected to occur during Tuesday's presentations.
            - It was suggested that the modelers jointly answer the EC's questions as opposed to each modeler making a presentation.
            - Some attendees were unclear on whether the presentations were intended to be a discussion of the similarities and differences between the two models or whether the presentations would discuss the use of the PVA models in the consultation.
            - There was agreement from attendees that using the allotted presentation time to go through the EC questions would be a useful use of time. It's also likely that the answers to the questions will trigger additional questions.
            - The compare and contrast of the models is important as are the descriptions of how the models will be used and what their utility is. As the PVA will be an intrinsic part of moving forward with the Program becoming a Recovery Implementation Program (RIP) any information that can shed light on how PVA is used in the context of a RIP will be important.
    - Meeting attendees reviewed the proposed answers to the MRGCD and NMDA questions.

- *MRGCD 1: Will a PVA model (either or both) be ready for use by the Program as per contracted schedule (functional model 6/30/12, training workshop 8/31/12, results report 9/30/12)?*
    - Dr. Miller was in agreement with the proposed answer that the models would be ready for use with appropriate caveats. The RAMAS model will be ready, meaning that it will have the appropriate data inputs and appropriate structure that should allow the user to test different management alternatives and proposed actions with the understanding that there will be additional discussion required on any new actions or additional actions that might require some modification or addition of some other model element that isn't necessarily being considered today.
    - The models will be ready by the contracted schedule but model development and the PVA process will be evolving as the needs change.
    - It was asked if the results of the PVA are the runs that the PVA workgroup will be doing.
        - Between the end of June and the end of September the reasonable and prudent alternatives (RPAs) will be constructed into modeling scenarios to test against the environmental baseline and the parameters will need to be discussed. Completing the analysis and the report will be dependent on reaching agreement on the RPAs that will be tested and the environmental baseline in a timely manner.
        - The Service representative shared that the deadline for submitting information to be considered in the consultation is July 31st, 2012. The current plans are for the proposed opinion to be front-loaded and there would not be RPAs. The July 31st deadline was developed to allow for a draft BO to be issued. If the action agencies did not want a draft BO then only a final BO would be issued and the deadline for submitting information for consideration in the consultation could be extended to the end of September; however, it is recommended that a draft BO be issued. If the deadline for information is extended past August 15th the opportunity for a draft BO is lost.
    - It was shared that the EC has discussed using the RIP as the conservation measure of the proposed action. In that case, the BO would not be a jeopardy opinion.
        - How does the lack of a jeopardy opinion relate to the Program being a RIP?
            - This means that the RIP is proposed by the action agencies rather than the Service requiring it as part of an RPA.
        - Instead of completing model runs based on RPAs the PVA workgroup would complete model runs that are based on the activities of the RIP. It was explained that RPAs are at the backend of a BO and are imposed as part of the BO; with the current plan to front-load the BO, the RIP will be upfront and part of the proposed actions as a conservation measure.
    - Meeting attendees discussed how the models will fit into the RIP
        - The RIP, as it relates to the PVA, is essentially a collection of activities or actions that are taken to move toward recovery of the species.

- Before the PVA models can test the impact of the RIP actions on the Rio Grande Silvery Minnow (RGSM) the PVA work group will need to know what the actions are and will need time to transform the actions into scenarios that can be tested in an effects analysis.
- There was agreement from the modelers that the models would be useful for a comparison of the proposed actions to "no action" as long as there is agreement on what the proposed actions are.
- It was commented that one of the issues that the EC is struggling with is predictability. They need some level of predictability with a RIP in order to commit to signing on.
- It was explained that conservation measures are activities that will benefit the endangered species. The Long Term Plan (LTP) is a big menu of activities that can be completed. The RIP Action Plan will be a more specific menu of activities to be carried out over several years and the annual work plan will be the activities that are carried out during a year. There are water management activities that cause some impacts and then there are conservation measures that offset those effects. The BO and BAs need to analyze the aggregate of the positive and negative effects. The BO is on the impact on the species as a whole and not for a specific reach.
- With some programmatic BOs the program is the RPA. Something that people may be interested in is whether there will be a suite of conservation measures, one of which will be the RIP, or if the RIP would be and encompass the suite of conservation measures.
    - The RIP will include all the activities for the RGSM. Ideally the activities will be sufficient to minimize the negative effects of water management. If the RIP is not formed there could be other conservation measures.
        - It was pointed out that there is a 10(j) population in Big Bend National Park but it may not fall into the authority of this RIP.
        - The EC will need to consider what it wants to achieve with the RIP if they decide to limit the activities to the Middle Rio Grande (MRG) then the goals need to be changed.

- Reclamation will be submitting their final BA to the Service on July 31st and that will trigger the formal consultation. The formal consultation could be triggered now if the BA was sufficient (a draft BA has been submitted to the Service) but since the BA is not complete then the trigger for the formal consultation will be July 31st.
    - The Service representative was asked if Reclamation and the Service will be identifying the actions or activities that need to be evaluated with a PVA or if the PVA work group will need to pull out the actions that will be analyzed.
        - The Service had hoped that the PVA would be used to do a relative comparison of different water management scenarios to see if any of the scenarios are better than the others. The Service submitted the types of questions that they hoped the PVA would address in August of 2010.

It's not anticipated that the Service will submit any other questions or resubmit those questions. If in the process of the effects analysis a question arises it's hoped that the PVA will be able to help to answer it.

- *NMDA 1: What can the EC do to facilitate a timely completion of PVA models to ensure their maximum benefit for use in analyzing BAs and preparing the BO in the MRG?*
    - Dr. Goodman explained that the PVA model is vulnerable to the quality of the data that is used. The usability of the PVA results will depend on the understanding and scientific security of the inputs. There have not been any PVA meetings to review the science of the inputs to the PVA to establish scientific acceptability within the Program and to determine the uncertainties. The inputs need to be discussed by the modelers, the scientists with the best knowledge, the Program, and the stakeholders who will depend on the outputs of the model.
    - It was asked if the EC could direct the contractor who collected the data to work more closely with the modelers to answer questions.
        - It was one opinion that the EC can and should be directing the contractor to work with the modelers.
        - It was asked if there has been any progress in obtaining the data that the PVA has requested.
            - It was shared that Reclamation has been going through negotiations with the contractor to obtain the data. As part of the negotiations it had been agreed that the data acquisition could be funded over several years; however there is not enough funding in the budget this year to obtain any of the data.
            - It was pointed out that even if the data was acquired this year it's not likely that it would be acquired in time to be useful in this consultation; though the data should be obtained at some point.
- *NMDA 2: How can EC members have meaningful participation in this complex process? Now and in the future?*
    - Meeting attendees agreed that the proposed answer that EC members attend and participate in PVA work group meetings and send questions to the PVA work group are the best ways for EC members to have meaningful participation.
        - Just being a part of the meeting and observing what is being discussed and the tensions in those discussions will give the EC some level of participation and will help the EC in decision making without EC members having to get into the details of the data and the models.
    - It was pointed out that while the EC should be sending questions to the PVA work group, the PVA work group in turn needs be responsive to the EC's questions. The questions that the EC has had on how the two models compare and contrast was posed to the work group some time ago. The EC has also directed the PVA workgroup to compile the consensus data sets that the models will use.
        - Addressing the Service's request for information that documents the development of the models would identify how each model is developed, how the parameters were developed, and the

assumptions that were used and will also address the EC's request for a compare and contrast of the models. The deliverables provided at the end of the PVA model contracts will provide the information that the Service is requesting.

- It was asked whether it would be appropriate for the PVA work group to advise, as part of the work group response, that the EC incorporate more science in decision making into the RIP governance structure.
  - There was some hesitancy from the modelers to tread into this area as it may not be appropriate. The interagency complexities are independent of the modelers. Once the structure of the RIP is determined the modelers and PVA work group can figure out the best way to use the PVA in the context of the RIP.
- The EC could be encouraged to have more updates and communication with their PVA work group member; however, this would not be possible in the situation where a Program agency does not have enough staff to provide a work group member to the PVA.

- *MRGCD 4: What must the EC be aware of when working with the regulatory agencies and PVA?*
  - It was suggested that additional language be added to the second part of the response to emphasize the need for updating as new information is obtained. The PVA is an evolving tool and given uncertainties and the nature of the relationships within our understanding of the system, the comparative nature needs to be analyzed. The PVA can give specific results but given the uncertainty in the understanding of the system there needs to be some understanding of the uncertainty around the results and what the uncertainty means to management.
    - The emphasis on uncertainty may be captured in the proposed answer to MRGCD question 7: Knowing the limitation on existing data, can the PVA models produce reliable and scientifically justifiable results?
    - There was agreement that the proposed answer to MRGCD 7 would address the issue of uncertainty.
      - The results from the PVA are within the context of the relationship of the certainty of the provided data. There needs to be some understanding of the level of prescription that can be obtained from a single modeling scenario. The PVA can say that one management action has more impactful results than another action. For example, the PVA can say that turning this knob up will have better results than turning this knob down, but the degree of turning can't be determined from a single modeling scenario. As complex as the analyses look they are still comparative tools. The assessment of the uncertainty will be part of the product.
  - It was suggested that the sentence "The process of PVAs serves to bring together and analyze the best available scientific information" be added to the response to MRGCD 4.
    - Meeting attendees agreed to add the sentence and to reorganize the document so that MRGCD question 7 is addressed in the same section as MRGCD 4.

- Attendees were in agreement that the PVA is a part of the body of the best available science and uses the best available science.

- *NMDA 5 – What is the PVA's role in peer reviews conducted by the EC, and can it be cited as a tool for MRG peer reviews?*
  - Meeting attendees were in agreement that the PVA models are not a peer review tool. The PVA isn't part of a peer review other than in the retrospective analysis of data that could be used as input.
  - Dr. Goodman explained that in his proposed answer he included two paragraphs in order to distinguish between the PVA model, which is a tool, and the PVA work group, which is a group of people to discuss the inputs and help develop the scenarios. The second paragraph attempts to emphasize that the model isn't a peer review tool. The model could, in its capacity for synthesis, tell you whether new information is important to the results of the PVA and if it's important in regard to risk and management of the species. There is good reason to schedule early analysis of new information by the PVA to see if the PVA indicates that the new information will make a big difference. However, the PVA will not tell you about the quality of information.
    - It was suggested that the order of the paragraphs be reversed as it's believed that the question is in regard to the PVA analysis as a tool and how it would be used in a peer review and not necessarily in regard to the PVA work group. However the first paragraph should still be included in the response because when information is included in the model there is discussion in the PVA work group of how the information fits into the model; in the past those discussions have revealed questions about the data. The process that the PVA workgroup goes through is an internal peer review.
    - The tool itself is separate from the work group's process. The PVA, as a tool, does not determine the relationship between flow and recruitment, the discussion within the work group determines that relationship.
  - Meeting attendees agreed to reverse the order of the paragraphs and to specify that discussion in the PVA workgroup can be a step in the *internal* peer review process.

- *MRGCD 2: Is PVA "best available science," and is it defensible should it wind up in court? And NMDA 3: Do regulatory agencies consider PVA models the "best available science" during the BA/BO process and for evaluating progress on recovery of the species.*
  - It was pointed out that a 1995 report "Science and the Endangered Species Act" indicates that PVA is the "gold standard". Also, in a 2010 paper by Dennis Murphy, the PVA is described as a specific kind of effects analysis that's designed to take the best available information and make sense out of it in an analysis of current conditions and prospective conditions. The PVA will use the best available science to make the best relative comparative analysis.
  - Patrick Redmond verified that, from a legal perspective, statistical biological analysis is recognized as being the best available science.
  - It was suggested that the sentence "It's anticipated that both PVA models will be the subjects of an external peer review" be added to the end of the proposed answer.

- It was commented that one of the aspects that is appealing about PVAs is that you can see the process by which conclusions are arrived at and evaluations are made. The conclusions may not be correct but you can see the way that the answer was arrived at as opposed to just having people look at data and give their opinion.
- In response to NMDA 3, the Service representative answered that the PVA is part of the body of knowledge that is considered the best available science. The Service hasn't received any results on any of the potential effects on the detailed questions. If the PVA is available and deemed useable then it will be used. However, depending on the questions that the Service is asking; the answers to questions may not come exclusively from the PVA.
- Meeting attendees agreed that the answer is a consensus answer with the clarification that the PVA is *part* of the best available science.

▪ *MRGCD 3: What information will the PVA provide that can be used by the Program and Federal Agencies while preparing the 2013 Biological Opinion?*
- Meeting attendees agreed that the proposed answer is a consensus answer with the following edits:
  - "…risk reduction by proposed RPAs and RPMs" be should be changed to "*relative* risk reduction by proposed *conservation measures*"

▪ *MRGCD 6: Can PVA be used for adaptive management, in particular when justifying difficult decisions and new water management ideas? And NMDA 4: What is the PVA's role in adaptive management of natural resources in the MRG, and can it be formally utilized within an adaptive management plan for the MRG.*
- Both modelers were in agreement that PVA is critical for adaptive management and meeting attendees agreed that the sentence "PVA is a critical formal component of adaptive management" should be added to the beginning of the proposed answer.
- Meeting attendees discussed how the PVA would identify future experiments as indicated in the proposed answer.
  - The PVA will point out the data gaps and in the process of evaluating an experiment the PVA could identify the needs for filling the data gaps.
  - The PVA will also help determine the priority for projects to be funded based on data needs. The PVA can indicate which experiment out of a suite of experiments would contribute the most information.
  - Meeting attendees agreed to change the answer to read "…identify critical uncertainties; *evaluate the potential of proposed* experiments…" in order to avoid insinuating that the PVA would develop the experiments.

▪ *MRGCD 5: If the Program does transition to a Recovery Implementation Plan, why is PVA important?*
- It will be difficult for the modelers to provide any more information other than what was provided in the proposed answer without knowing more about what the RIP would look like.
- Meeting attendees were in agreement with the proposed answers with the exception that "define" be changed to "propose". The PVA doesn't

define. The PVA process can identify the metrics that are likely to be useful; however, that is more of the PVA process as opposed to the PVA.

- Meeting attendees discussed that the word "justify" may not be appropriate.
    - Dr. Goodman explained that if you have recovery criteria that are phrased in terms of probability of extinction in a number of years the only way to know if you are moving closer or further from the probability is by carrying out the PVA. If you propose your index of progress will be "x" percent change in the number of fish in each reach, that index can be plugged into the PVA and the PVA can say if it's moved closer to or further from the risk of extinction. The PVA becomes the test of whether the metric you proposed is moving you in the direction you want to go.
    - It was commented that a PVA is more like an evaluation of indicators. "Justify" would suggest that the PVA itself is providing validation.
    - Given that there are recovery criteria that have been developed the word "justify" can be used. The PVA can justify whether a body count is moving you forward. The PVA is justifying the indicator of progress but not the choice of that indicator.

- Meeting attendees discussed how to address the Service's questions posed to the PVA work group in August of 2010.
    - It was commented that it would be worthwhile for the PVA work group to have a discussion on what it means to validate the PVA and the types of things an internal review of the PVA could look at.
    - The PVA products that will be delivered at the end of the contract will address the Service's request for: background information; a list the data used; a list of assumptions; an explanation of how the model parameters were developed; and the PVA results.
    - Meeting attendees were in agreement that the modelers could answer the questions on some level of detail in order to inform the Service which questions they can expect to have answered with the PVA and which ones the PVA will not be able to address or will only be able to partially answer.
    - Service Questions 7 and 8 (critical habitat and primary constituent elements) are not in the PVA's purview. The PVA work group has had various conversations on habitat and fish demographic characteristics; however, in terms of formalized critical habitat designation the PVA is not set up to address questions 7 and 8.
    - It was commented that it will also be helpful for the PVA to think of the questions in terms of what could potentially be answered by the July 31st deadline.
        - Dr. Goodman and Dr. Miller may decide to split the questions by determining whose model would be more appropriate to answer each question. Also, given the new July 31st deadline for incorporating information into the consultation the PVA work group may need to discuss the priority of the questions in order to focus on the questions that they think will be most important to answer for the consultation.
        - It was noted that the Service's questions were provided to the PVA work group in August of 2010 with the intention that the PVA would inform the BAs. The consultation deadlines have remained the same and the Service has not cast any new deadlines.

- There was some clarification that contractually it was understood that the models would be completed by the end of June and then the modelers would then have from the end of June to the end of September to provide results. The contractual deadline is not consistent with the Service's consultation timeline. The PVA work group has gone through the Service's questions and has been working extensively to gather and analyze at length and with great detail the types of data that can be brought forth to answer the questions. There is a model that is available that has to some degree answered parts of the Service's questions, though on a basic level. The work group has also been working to develop a consensus data.

- *Service Question 6 (river drying):*
  - The models don't have a framework in place that the PVA workgroup is comfortable with to answer question 6; however, the PVA work group could make an assumption that for every kilometer that dries "x" percent of fish are lost and then the PVA could analyze that assumption.

- *Service Questions 1 – 3* are more about the implications of the outputs; the effects of the proposed action on population viability. Scenarios haven't been developed that collectively define the proposed action. Once the scenarios are developed they will need to be run against what is defined as the baseline. The answers to questions 1- 3 are contingent on developing scenarios and running them in the models.
  - It was asked if there is a proposed action.
    - The proposed action for the Corps is their discretionary flood control operations and Reclamation's proposed action is basically what was proposed in 2003 with a much reduced supplemental water program.
    - In order to build scenarios the general verbal description of the proposed actions will need to be translated to very specific quantitative descriptions.

- Meeting attendees agreed that the proposed answers to the MRGCD and NMDA questions, with the inclusion of today's edits, are the workgroup's consensus answers and that Dr. Miller will brief the EC on the PVA's ability to address the Service's questions. Attendees also agreed that the answers should be read by Reese Fullerton (EC facilitator) and presented as a consensus document from the PVA workgroup. Dr. Goodman will incorporate today's edits and distribute the revised document to Reese Fullerton and the PVA workgroup.
- Attendees discussed Tuesday's PVA presentation to the EC and agreed that it would be more appropriate to have a roundtable discussion with questions and dialog as opposed to actual presentations.

DAY 2: Tuesday, May 25th, 2012 – Brief Preparation Meeting for EC Session

- Lori Robertson (acting Federal Co-Chair) brought the meeting to order.
- Meeting attendees were given a brief update on yesterday's PVA work group session.
  - Meeting attendees then discussed the addition of edits to the PVA document answering EC member questions that had not been incorporated into the revised version.

        - Attendees were able to reach consensus on the addition of the edits and Lori Robertson made the edits to the document to be distributed during the EC meeting.
    - Meeting attendees then discussed that there may be some confusion in using the term PVA. The PVA is often thought of as the model; however, the PVA is a process that includes the use of a model.
- Meeting attendees were then invited to join the Science (ScW) work group meeting until the EC presentations scheduled for 12:00 pm.

DAY 2: Tuesday, May 15th, 2012 – Model Presentations/Question Review with the EC

- Please refer to the May 15th, 2012 EC meeting summary for the details on the PVA presentations to the executives. *Once approved by the EC, these notes will be included in full detail here.*

DAY 2: Tuesday, May 15th, 2012 Afternoon Session

Report Out on PVA presentations to the EC

- David Gensler brought the afternoon session of the PVA meeting to order. The discussion opened with review of the EC directive that was provided earlier in the afternoon. Attendees discussed the modeler's contractual obligations (including trainings) and the upcoming deadlines and schedules.
    - *The EC directed the PVA work group to determine during the remaining May meeting time, what could be accomplished by June 15th in order to inform Reclamation's draft BA including the possibility of modeling the baseline and proposed action(s) scenarios. The PVA work group was tasked to meet in early June in order to (1) review and discuss (internal review of) Dr. Goodman's RGSM 2010 Revised Recovery Criteria in Relation to Population Monitoring Draft Report dated May 1st, 2012 and (2) discuss and resolve the incorporation of hydrology/hydrologic scenarios into the PVA models. The PVA work group should also determine what can be accomplished by the Service's August 15th, 2012 information deadline and meet as often as necessary to accomplish this; additional PVA briefs to EC will also be scheduled.*
    - Based on the contractual obligations, Dr. Miller has to provide a working model by the end of June, a 2-day training in August, and the final reports and documentation in September.
        - Members discussed the original assumption that the actual model runs were to be completed by the agencies themselves. The purpose was to "get away" from having to send the modelers a new scenario every week to get results for small tweaks and changes. However, it was cautioned that it is really difficult to train someone to be a functional user of such programs; it is like a language that has to be used regularly and often.
        - It is unknown if Dr. Miller will be re-contracted after his September product submissions, but given the complexity of the models and the system, it is hardly possible that a single training would provide the necessary "expertise" for the Program's technical members to be able to run meaningful analysis and provide the annual updates to the model parameters. It is assumed that the modelers will be needed for continuing updates to the models over time.
    - It was shared that the Program will be pursuing a "demographic criteria and CPUE metrics and methodologies" workshop slated for sometime this summer. It was suggested that the PVA model trainings could be schedule to coincide with this workshop.
    - As far as using the model for the purposes of the BA/BO/RIP/AM, the management actions will have to be "translated" into species demographic data for inputs into the models (ex. CPUE data into survivorship).

- It might be feasible, if given the necessary information, to run the "no action" and "proposed action" scenarios to see what the preliminary fish population response could be.
    - In terms of specific conservative measures (such as augmentation levels, fish passage, habitat improvements, refuges during drying, etc.), if Reclamation can develop these, then the models can provide feedback that Reclamation could use on a short-term basis to confirm or refute preconceived ideas on the accuracy of those conservation measures.
        - Right now, the conservation measure is the Recovery Implementation Program (RIP) which is defined by the actions as listed in the RIP Action Plan and Long-term Plan (LTP). Reclamation has to get the RIP as robust as possible to show offset (minimized impacts) to the water management actions.

Hydrology data for use in PVA models, what do the numbers mean, and options?

- David Gensler then presented hydrology information that Reclamation submitted as part of their May 7th Draft Biological Assessment (BA) to the Service. Reclamation currently has 1 50-year sequence derived by "stringing" together 5 10-year exceedance scenarios that was generated through URGWOM and the PHVA process. This single 50-year hydrology sequence was run through URGWOM for a "no action" scenario and for the "proposed action" scenario. In other words, the years and sequencing of the years are the same but the operating rules are changed to reflect a "no action" situation and the "proposed action" situation. David explained that he post-processed the information taken from the Draft BA to attempt to arrive at hydrologic information that would be useable in/for the PVA modeling process.
    - For the "no action" scenario, the "optional" water operations are "turned off" - for example, the Districts storage and release. It was pointed out that "no action" does not mean "no management." All preexisting operations would remain in place.
    - By summing the exceedance results, David was able to get tallies on the total amount of drying, the number of years where spawning was met, etc. However, several members expressed concern that the "summation" of results as it is not accurate approach and has not significant meaning that the PVA models could use.
        - Dr. Miller explained that the RAMAS model uses a flow-transformed-fecundity to develop a prospective time series of population abundance over time; that information is derived from the conditions in the model during each year of simulation. In other words, a set of flows over a 50-year period are transformed into a fecundity factor that the model can apply survival rates and spawning conditions year to year over a certain period. The RAMAS model needs a functional relationship between flow and fecundity (flow x = fecundity y) that can be applied over a 50-year period. And because flow is not random from one year to the next, the hydrologic data that was presented is not useable by the RAMAS model.
        - Stringing the 5 10-year sequences together loses the patterns of the cycles (ex. 2 years back to back drought). There needs to be greater understanding of how the "blocks" are being "fit together" and the effects of periods of good years and bad years. The intensity of the flow also has to be understood – in order to get to the intensity of the reproductive output.
            - It is unknown if realistic and representative scenarios can be made by stringing the sequences together.

- Dr. Goodman cautioned that this work cannot be rushed or mistakes will be made. Everything has to be deliberate and done thoughtfully in order to be comfortable that the science is defendable. Unfortunately, it will take time that we don't have. Instead, Dr. Goodman suggested that the PVA modelers provide statements indicating what has been learned through the explorations and analyses

done to date. For example, "*given what we know so far through all the explorations and analyses done in the PVA work group, this is the most important insight to date*."

- In response to a question on how this would help the agencies, it was responded that it will only help if they listen. It is not an academic insight but rather an insight that matters to the management. It might include perspectives that could change their ideas on what the RPAs and RPMs could be. It could be considered educational and possibly a "game changer" for the agencies if there is improved understanding of the relationships that can be teased out of the data. Dr. Goodman shared his opinion that he is not comfortable trying to "patch" something together in a rushed response to unrealistic deadlines.
  - The purpose is to communicate what the work group has learned to the action agencies in a way for them to address and analyze. Dr. Goodman shared the opinion that it is probably more important and more useful at this point in time since there is no confidence that the PVA work group can deliver a minimally complete model within the requested time frame. And it certainly won't be peer reviewed.
  - Although, it was pointed out that a sensitivity analysis on flow parameters using the historical flow data could be done.
  - Dr. Goodman shared his assumption that the density dependence and habitat are the critical components. Manipulation of habitat and the water management affects (scouring) are really important and within the scope of what can be done.
    - It was clarified that understanding the density dependence could actually lead to providing *less* water.
  - In terms of the EC and Service questions that were provided to the work group, Dr. Goodman pointed out that most of the issues are (1) things that we know so little about at this point that there is no sense in trying to model those; or (2) are things that can be modeled but are in the "noise level" in terms of the importance to the population and management. It was thus recommended to focus on the top factors that the work group thinks are really key to the survival of the population. This would make a more impressionistic model because things that are not considered as important are being intentionally left out.
    - Dr. Goodman also suggested that he could look at the 20-year hydrology record – while it would not be a future prediction, this exercise could indicate how the system works (ex. this management option has more influence than this management option).
    - What is needed is an impact assessment or effects analysis. Reclamation has to show their proposed conservation measure minimizes the effects of the actions and water management. The hope is that there will be no RPA. The conservation measure is the RIP – which is comprised of multiple individual activities.
      - In order to get PVA assessments, the suite of conservation measures needs to be specified and translated into parameters the model can simulate.
      - Currently, Reclamation is proposing 2 flow scenarios – the "no action" or bottom line operations (COA, Santa Fe, flood control ops, etc.) and the "proposed action" which is essentially to continue doing the suite of management that has been/is being done in the absence of the supplemental water program.

- Attendees then discussed the need to have enough runs to be able to determine differences. Concern was expressed that the models are being supplied with a single 50-year water scenario out of all the infinite options. Without the error the model cannot determine the impact on the fish. No conclusions or statements can be made from a single model run; any model outputs would basically be in the range of "noise."

- It will be very hard (and impossible to defend) for the PVA models to be able to resolve any differences between a "no action" and "proposed action" hydrologic scenario for the fish since there is no indication of the error or uncertainty around either. Any "difference" could be attributed to noise in the system or within range of acceptable variable. It is too small a sample size to draw any conclusions about the frequency of the event.
- Based on graphs from the Draft BA, attendees pointed out that there is basically no difference presented between the 2 scenarios.
    - The only way to get to "real information" is to run many more tests in order for the "luck of the draw" or "chance affects" within the natural variation to cancel out.
    - Including error bars is the only way to show any statistical difference between the proposed action and no action scenarios.

- Attendees then discussed the issues with flow and changes to the river system (i.e., habitat destruction). The problem is learning how to manage flow in light of the lost habitat. The river is small compared to how large it used to be so we have to figure out how to create that habitat with what we have. It would be ideal to use the PVA to figure out how to optimize flow – to get the needed habitat - along the river for spawning success, nursery habitat, refugium, etc.
    - Habitat is one thing we have control over and can address. However, habitat is also a function of flow. The nuances in the morphology between the subreaches have to be understood and acknowledged. These gradations of change in habitat in response to flow changes have to be considered in the water operations.
    - The Program needs to explore technics to increase in-channel habitat.
    - The analysis of the density dependence could inform the conservation measures.
    - There needs to be continued discussion on to functionally utilize habitat information in the models if the mesohabitat in and between the reaches is not specified.

- Attendees discussed that there is nothing the PVA can do here that can fix the problem the PHVA has caused in terms of providing a hydrology output where the signal cannot be distinguished from the noise. The one sequence provided and the results from simulations built on that have dubious statistical validity. In an attempt to find possible resolution, the work group then revisited potential options to get the hydrology information the PVA models need.
    - One suggestion was to look at the record for the 100 years and do a selective randomization of the data and then superimpose the proposed action.
        - It was responded that there is no record of appropriate resolution for the full 100 years and since major changes affecting the hydrology occur at regular intervals throughout that time (every 20 years on average). Besides, the world today doesn't look like it did 100 years ago and the proposed actions have to be framed in terms of today.
        - It was clarified that the "no action" is not like simulating the river in the 1700s - it is not just a "let the river do its thing." The no action scenario still contains preexisting operations (such as the City's drinking water diversions, the Corps' flood operations, etc.). It will still be a heavily managed scenario.
        - In terms of supporting the Service's development of the Draft BO, it was explained that the effects of the proposed water management and proposed action need to be analyzed. Basically, there is a stressor and a resulting population response. It was shared that a "no action" scenario is not needed for comparison.
            - Attendees then discussed the need for a baseline for comparison purposes. The baseline cannot be divorced from the affect(s) of the action(s).
            - It is not a matter of "is the action good" or "is the action bad" but does the action have any additional impact *compared to the baseline*.

- It was clarified that the Service has to know, given some flow of water in the river - temperature, depth, velocity, etc. - how does that particular moment in time affect the minnow population?
- Dr. Goodman then referred attendees to Chapter 4 page 33 in the Service's Consultation Handbook for explanation of baseline comparisons. The key quote from the Handbook is "The conclusion section presents the Services' opinion regarding whether the aggregate effects of the factors analyzed under "environmental baseline," "effects of the action," and cumulative effects" in the action area—are likely to jeopardize…"

- Returning to the discussion on the lack of hydrologic sequences, members revisited the need for error bars in order to determine what an appropriate sample size might be.
  - Even with the discomfort expressed with stringing 5 10-year blocks to reach a 50-year sequence, it still only provides 1 sequence! No amount of biological randomization built into the model(s) will solve the problem of inadequate hydrology sample size.
  - It was suggested that the 2010 pre-ESA URGWOM model runs might be "resurrected" to determine usefulness. Unfortunately, those model runs did not include the City's diversions so they are too antiquated for use.
  - Another suggestion was that the Platania data on the acre-feet at a gage in April/May or May could be tied the fecundity in October to develop a sequence over time.
  - The problem with tying sequences built on the 10%, 30%, 50%, 70%, and 90% exceedances is that there is no randomization. A random process might put 2 30% blocks back-to-back which could have an effect on the population.
    - Even with this one 50-year sequence, the flow lines cannot be distinguish (without error bars) so the models won't be able to functionally distinguish the fish response to those flows.
  - Another suggestion was to revisit Jesse Roach's monthly time-step model but this model was overly simplistic in terms of not modeling all the operational rules. Besides, a daily time-step is preferable. *(Note: At the June 11th and 12th PVA meeting attendees were notified that Jesse's model does include monthly operations)*
  - It was also questioned whether the supplemental water could be subtracted in order to get to a more accurate "historical" record.
  - In response to a suggestion to use the past 50-year record as a foundation for a no action (i.e., overlay the no action on top), it was explained that the record for the last 50 year includes *proposed actions.* The no action alternative has never occurred. There have always been management actions occurring - and those are what are proposed to be continued.
  - Even though the 10-year sequences are not biologically meaningful, it was proposed that the PVA consider using them because *it is all we have been given* and we are running out of time.
    - It was pointed out as ironic that the recovery criteria are for 100 years and the PVA is barely squeezing 50 years of hydrology information out of the PHVA.
  - Another suggestion offered was that the modelers write a very specific statement on what is needed in order to evaluate the no action and proposed actions. The statement should specify that the models cannot utilize what has been provided and in lieu of that, the PVA will do a, b, c instead. Advice could be given by highlighting the insights that have been achieved through the PVA process. It won't be a mechanical running of the model but a lessons learned.

- In conclusion, attendees briefly discussed adding a recap of today's discussion with a Reclamation representative present - acknowledging the issues with the hydrology that Reclamation has used put into the Draft BA and explaining that the "ball is in Reclamation's court." If appropriate hydrology

information were to be provided quickly then the PVA work group might be able to produce preliminary information to inform the BA and BO.

DAY 3: Wednesday, May 16th, 2012

Opening

- David Gensler opened the 3rd and final meeting day for May. It was recognized that based on the discussions, hydrology concerns, and EC directive, the original draft agenda would probably need to be revisited.

December 12th, 2012 Action Item Review

- It was proposed that the action item review be postponed due to the significant delays between meetings. However, some members did have updates to their actions so a partial action item review took place.

Other Individual Assignments/Actions

- Jason Remshardt and Mick Porter will provide electronic copies of the river channel resetting studies done for Big Bend, Texas. – *ongoing;*
    - It was clarified that this is Jack Schmidt/David Dean study instead of the Bruce Mooring work. David Dean did a channel geomorphology study in Big Bend so the intent behind the action was to provide the studies to the work group for information on how the channel planform has changed over the years (ex. assumed highly incised previous to 2008). The group could gleam ideas on how the flood reset the channel and the effects on habitat.
    - Also, the study may contain information on the conditions for the 10j population that could be informative to other potential 10j populations. It is basically another set of data to explore what makes good habitat for the minnow.
    - ***Question:*** Through this process of looking at the geomorphology and planform of the channel for supporting minnow, will our investigations go further detailed into the subdivision of the mesohabitat units including what units are available at different flows and support what life stage of the minnow?
        - ***Response:*** Yes; getting to the mesohabitat level is the direction that ScW and HR are heading. Getting a handle on the mesohabitat is a very important step to understanding what the minnow needs. – We are moving toward that "tiering" of more specific levels of mesohabitat descriptions and we will eventually get there.
        - This raises the question on how is a research plan laid out for the PVA to get that data? Are there inventory/maps/GIS of mesohabitat quantity that we could have access to? We have already identified and requested the by-seine haul data for fish by mesohabitat. If necessary, the work group could formalize a renewal of those data requests.
            - And unfortunately, there is not an inventory of mesohabitat for the entire river. There are some representative samples that could be examined to determine if the sample sizes are large enough to extrapolate.
            - ASIR mapped the mesohabitat for the population estimation study but not for the population monitoring. They identify mesohabitat where they sample but they don't actually map them.
                - Dr. Goodman suggested that there needs to be communication with Rob Dudley to understand how they picked the population estimation sites and how they documented that those sites are representative.
                    - It was explained that ASIR used GRTS models for a random sampling; they didn't distinguish by reach or stratify by morphology type.
                    - But that work could be done after the fact. This could be doable work in the year ahead. But to the extent that it

involves a data request, that request needs to be formally submitted.

- In October, ASIR maps the entire site including mesohabitat designation in that section of river – this means that there is a narrow range of flow for those measures. There really isn't information on the mesohabitat for other flows.
  - However, Mick Porter has been working on the inundation at different flows. Also, the USGS mesohabitat mapping project in the MRG is targeting 2 different flow regimes (which probably account for 90 to 95% of the days in the river): (1) a winter flow (baseflow) and (2) a summer low flow. The spring runoff was dropped because (a) there was no real peak this year and (b) summer flows might be more useful. They are trying to repeat the 2003-2007 Service work with some additional sites.

- Alison Hutson and Mick Porter will talk with Jericho Lewis about how to transfer collected minnows (samples) so they can be provided as government supplied materials and thus allow for easier extended study and research (as opposed to limited to the contract requirements). – *incomplete;*
  - Jericho Lewis has been busy and this is not a priority in the current set of deadlines.

- Rich Valdez will put together a strawman on existing information on the fish/flow relationships to get a running accounting of the information out there; he will send the draft strawman to Mick Porter for feedback. – *incomplete;*
  - This action is related to the current conversations – the main thing is to target the needs of the PVA relative to what habitat information we need to secure. From the current discussion, it sounds like there is some data that can be brought together to develop a starting point. However, there probably needs to be a data request that is specific to what information we think is available.
  - If the fish information by mesohabitat type (in the by-seine haul data) is provided, it will give an index of abundance by mesohabitat. Then, if we can bring the mesohabitat area information together (surficial mapping or aerial determination) by different flows we can get to a flow to mesohabitat to fish relationship. This can be done for each reach.
    - It was cautioned that developing this relationship will partially depend on (1) what data is available and (2) what condition the data is in.
    - The language in the critical habitat designation is specific to PCEs – although pools and backwaters and other mesohabitats identified. There are some that include flow ranges in cfs.
    - Depth, substraight, velocity, and temperature are the specifics mentioned.
      - The mesohabitat data that Mick is collecting doesn't include that detail.
      - The population monitoring doesn't include depth or velocity information either. However, Yvette Paroz will check the population estimation data that has been provided to see if depth, temperature, velocity, etc. has already been provided.
        - Yvette Paroz will also check the ASIR data to determine if the mesohabitat/surficial area is in GIS or electronic file formats.
  - ***Question:*** Mick – what is the deviation of the flow/habitat relationships over time? How variable is that flow/habitat relationship over time?
    - ***Response:*** There are 3 specific places that have undergone significant change in the last 10 years: (1) Isleta – experienced sediment influx and filling of bars in 2005; (2) armoring of the channel from Cochiti to Perales/Alameda; and (3) the head cut from Elephant Butte to the Refuge. These are 3 examples of that relationship being very

dynamic and changing over the last several years. But the rest of the system tends to be more stable. In fact, the USGS mesohabitat mapping sites were picked to help make those comparisons before/after 2005.

- Jason Remshardt shared that he is trying to write a synopsis of all the habitat measurement projects done on the minnow. His goal is to have it done by the end of year but that might be unrealistic. It would be great to have the synopsis completed in time for the USGS to tie into their mesohabitat mapping project. Jason clarified that he is not getting all the data but compiling where people caught the fish.

- Review of known habitat and related datasets:
  - *Habitat Datasets*
    - 1.ASIR RGSM Population Estimation in GIS format from October; contains no depth/velocity/substraight information;
      - There were earlier years where the information was collected but it was not a deliverable required by contract.
    - 2. USGS Dataset (M. Porter/USGS for MRG and Big Bend) – data is still being collected this June and August; GIS based and contains fish collections for Big Bend; collecting depth, velocity, substraight, etc.
    - 3. Bovee IFIM (2-D PHABSIM) – no fish data
    - 4. Misc. FWS: no site mapping but does contain depth, velocity, substraight, etc. as well as fish data;
    - 5. Miller for URGWOPS – 5 MRG sites, similar to Bovee but 1-D, no fish data;
    - 6. Inundation Analysis (COE) – HECRAS model
    - 7. 12+ minnow fish habitat use studies;
    - 8. SWCA Food Availability Study – had some surficial habitat mapping

  - *Fish Datasets* (by seine haul 2006-2011 and seine haul w/ mesohabitat 2010-2011)
    - 1. ASIR Population Monitoring by seine haul; including mesohabitat records starting in 2007/2008;
    - 2. FWS Population Monitoring – 1999 to 2001; with mesohabitat included 2002-2012;
    - 3. Reclamation –fish datasets that include information on depth/velocity/substraight;

  - *Discussion*
    - There may be some data that Dr. Goodman has on his website that is not currently available on the Program's website. However, everything that has been provided to date is on Dr. Goodman's site. It was requested that the Program website "mirror" Dr. Goodman's so that as data is collected, the site will automatically update.
    - It was pointed out that the mesohabitat designations for the 2006-2010 file of fish information by seine haul (provided by Yvette in December) would be extremely useful. However, there is a contracting process to follow in acquiring any data that was not an original deliverable.
      - In a brief update, the PVA work group was informed that Jericho told the CC that the data acquisition with ASIR is still being negotiated but is around $600,000 to complete.
      - Jason indicated that the Service's data is probably a bigger, more complete set that could be used for an analysis now instead of waiting for the ASIR data, especially considering there is a lot is overlap/duplication.
      - The corresponding mesohabitat data for the population monitoring would be nice, but it was acknowledged that the group may have to rely heavily on the FWS data.

- ***Question:*** Are we targeting the entire population or can we look specifically at the end of the year? Is it important to identify the success of the cohort through the first year?
  - ***Response:*** The population monitoring data and Jason's data both have Age 0 and Age 1+ partitions/designations. There are age categories.
  - In terms of management and flow, one target is to look at the young-of-year to get them to recruitment. It is hoped that the age class specifics can be teased out of the habitat information.

- Concern was expressed that CC/EC does not understand the importance of the data requests/acquisitions. While it is acknowledged that budgets are rapidly decreasing, securing the data will make the PVA extremely useful for informing the tough decisions.
  - Population estimation is not continuing next year and never are several other projects (because there is no money to fund them).
  - Concern was expressed that this is a short-lived species (~2 years) and missing 1 or 2 years of data could be critical.

✓ Tetra Tech will redistribute the Corps' Inundation Analysis Presentation (S. Kissock?) to PVA work group members. – *complete;*

- Grace Haggerty will forward the Doug Wolf "I40 to Central Inundation Presentation" to Mick Porter. – *unknown/incomplete;*
  - Peter Wilkinson will follow up with Grace Haggerty on her action (from December 2011) to forward the Doug Wolf "I40 to Central Inundation Presentation" to Mick Porter."

- Mick Porter will lead a review group on the inundation habitat literature to date to inform the upcoming USGS work on the inundation habitat. – *incomplete; no longer pertinent;*
  - A review of inundation habitat literature was never completed. However, the project has since been changed to include summer habitat instead of spring flows.

- Mick Porter will summarize site complexity standardization literature in relationship to the Middle Rio Grande. – *incomplete;*

✓ Input on the Longitudinal Movement project and RGSM Life History scopes of work will be submitted to Stacey Kopitsch by mid-January. – *complete;*
  - These projects did not get funded this year.

✓ Dave Campbell will pursue getting a copy of the Arizona student thesis and flycatcher PVA; he will provide these to Tetra Tech for distribution to the group and posting to website. – *complete;*
  - The student is not available to come present or talk with the work group at this time. The Flycatcher Recovery Plan in AZ references a PVA (and it is assumed that that PVA is the same model developed by this student).
  - Unfortunately, there was a complication with the habitat patch size so the model was never fully completed. The perspective of the Reclamation flycatcher biologists is that the model is already 10 years old and since it was never fully completed, it will not be particularly useful.
    - It is thought that the student's thesis is a separate thing and may be more recent.

Agenda review:

- In a brief agenda review, attendees highlighted 4 priority discussions that need to occur during the remainder of the meeting: (1) consensus data set - agreement is need in order move forward; (2) revisit the hydrology discussion (from yesterday) with a Reclamation representative present; (3) RIP

transition updates (L. Robertson); and (4) PVA usefulness for the RIP and sufficient progress metrics (P. Redmond).

- Due to travel arrangements, both modelers had to leave by 3:30pm in order to make their flights.

Presentation on Cochiti Deviations and PVA use (M. Porter)

- *Cochiti Deviation Update*
  - The purpose of the deviation is to provide temporary retention and release of spring runoff flows for fish recruitment and overbanking flows through the Middle Rio Grande (MRG) valley to enhance the natural peak. The targets are: 3,000 cfs for 7 to10 days for a recruitment event and 5,800 cfs for 5 days for an overbanking event.
    - A deviation is called for if Mother Nature doesn't appear to supply the targeted flows but there is enough that the Corps can augment to achieve the target flows/duration.
  - This year, a 2-year extension to the initial 3-year deviation was requested and received.
  - Earlier this year, the conditions looked favorable for a deviation (as of the February 2012 forecast).
  - Normally, the process isn't initiated until after the April 1 forecast but runoff came earlier this year, so the decision was made to start storing earlier. But then the April forecasted volumes and peaks would not meet the flow target. It was determined at that time that the deviation could not be met. There was a risk to storing the water but never getting a second peak which could result in significant loses in the system (estimated up to 1,000 ac-ft). The 3,500 ac-ft that had been stored was released over the course of the subsequent week.
    - This is the earliest peak experienced – on March 31st - since 1975. It is assumed that flow won't get above 1,500 cfs at Central for the remainder of the year.
    - In general, the minnow threshold is above a daily low temperature of 15° C. However, the peak occurred this year when it was still too cold. The City was on the river but didn't observe minnow until closer to May - after it warmed up.
    - Since early April, there was a small secondary peak around 1,500 to 1,600 cfs out of Cochiti for about a week. Flows are currently down to about 1,100 cfs.

- *Cochiti Deviation Analysis*
  - Mick Porter then shared that the Cochiti Deviation was part of a 5-year study to understand environmental flow for recruitment and to inform adaptive management for the minnow. At the end of the 5 years, a decision needs to be made on whether or not to request permanent changes to the water control manual process. Any changes have to be justified to the Corps' change of command and then to congress as well. Rigorous analysis needs to be done – to determine what is or is not working, what can be made better, is the deviation meeting the needs of the minnow or not, etc. This is the first year of the 2-year extension so one year remains before this decision has to be made. The Corps would like to begin the analysis process now so that informed decisions on how to proceed can be made within a year.
    - This presentation was a brief introduction to the analysis. As the analysis is pursued (to determine the success and needs of a deviation, and if changes need to be pursued through congress) participation and feedback from all Program partners was encouraged.
    - There are 3 main things that need to be understood: habitat requirements for recruitment, flow magnitude, and flow duration. The combination of magnitude and duration creates the minnow habitat.
      - Stronger juvenile production has been observed with higher and longer flows. Flow magnitude and duration are correlated with seasonal volume. That seasonal volume of higher flow may actually be building the food supply that supports the recruitment.
      - Part of the analysis is to evaluate sufficient flow and define what might be insufficient flow for recruitment.

- 5 days is the minimum length of time from fertilization to first feeding (Critical Period). Hatching occurs between 35 to 48 hours after fertilization (resorption of the yolk sac occurs within 2 to 3 days). The larval minnows need to eat within 5 days from fertilization as the yolk sac is gone and the fry is mobile.
- The fish goes through a technical larval stage with 3 subphases (pro, meta, and meso-larvae). The idea is to provide them with safe habitat until they have sufficiently developed fins and can manage for themselves in the channel (instead of just floating).
    - From the analyses to date, 7 days is a minimum based on the spring flow to fall recruitment.
    - It is typical for larval fish to starve if they do not find food within hours of absorbing the yolk sac (Critical Period). It is not enough to produce larval minnows , they need that first meal in order to survive.

- ***Comment:*** Maybe we've been pushing the declining limb of the peak too fast.
    - ***Response:*** With the deviation, there is a reasonable ramp-down rate of 250 cfs per day. There is more emphasis on rate of recession instead of the peak discharge.
    - "Shaving" the peak volume to create a slightly decreased peak and putting the water on the declining limb of the hydrograph is one way to create the duration needed.
    - It was pointed out that the depletions for the deviations executed have been a couple of hundred ac-ft. However, that could increase (to 1,000+ ac-ft) if held longer due to evaporation and down channel with much lower baseflow.

- ***Question:*** Dr. Goodman, have you looked at fish and CPUE numbers in terms of discharge duration?
    - ***Response:*** The analysis was 2½ years ago, but there were high correlations among the attributes of spring peak: peak magnitude, duration above any cfs threshold, total volume between May and July, etc. At the time of the analysis, it wasn't possible to separate those characteristics of the spring pulse to determine which was driving recruitment because they all operate in concert.
    - It is not known how many years of data it will take to answer that question; but the work group could discuss what could be done with the monitoring in order to get to an answer sooner. Things with flow manipulation should be the first active on-the-ground AM to get to answers sooner instead of later.
        - In terms of AM, this is an excellent first activity: the hypothesis seems plausible; there is hardly any downside since it is probable that it is helping the fish and the situation is not likely to harm the fish. It is the perfect AM experiment for the Program to "get their feet wet."
        - Then, as better recruitment estimates become available, it might be possible to tease apart the characteristics of the spring peak to see which are coincidental versus those that are driving the recruitment. AM could be implemented to

try to produce the different kinds of peaks to see which work better for the same amount of water.

- There is a strong relationship between the May mean volume (May mean discharge) and the October CPUE. It is assumed that this relationship is related to inundation – newly wetted habitat and how long it stays wet. It may not be totally linear either. There may be value in exploring different flow strategies based on the expected volume. For example, based on the April forecast volume, there might be 2 or 3 different strategies based on whether the flow is expected to be low, medium, or high volume.

- Returning to the presentation, Mick continued by explaining that annually quantifying the estimated inundated habitat (in acres per mile) as a function of flow peaks will be very informative. Below 3,000 cfs there is a recognized decreasing amount of habitat for larval fish. However, the "break points" on production of a certain number of fish are not yet known. It is hoped this analysis will provide information on the thresholds and the minimum flow level needed to produce inundated habitat (and for how long).
- The focus of the deviation is not the final population but the production of juveniles that support the population. Since 2002, both July and October CPUE data has been collected for comparison purposes. The interest is in the trends of the minnow production. Part of the analysis will be to determine whether or not the deviations produced recruitment – in order to evaluate the action.

- ***Question:*** How likely is a Cochiti deviation to be called?
  - ***Response:*** We expect to hit the flow criteria about 50% of time, and about we expect to have a successful deviation in May about 25% of the time.
  - It was cautioned that recruitment following a deviation may be in response to the deviation or it could be a response to another flow event. There could be 2 groups of fish: (1) those that responded to the deviation and (2) others that responded to some "normal" event. Both groups would be summed in the July monitoring. This could be a confounding effect that should be considered.
    - Because of the correlation of the magnitude, duration, and seasonal volume, it has been proposed to look at an experimental period in order to actively identify the relative contributions and effects. For example, does a deviation for a certain flow volume one year and then chose not to do the deviation during another year with similar flow volume – for comparison purposes.
    - In terms of "other natural events", the deviation is really early in the water year so the associated increase in larval fish has to be detected/monitored close to that (time-wise) or the noise from other hydrologic events later in the year could "cloud" the effects of the deviation. Maybe monitoring efforts need to be refined to look at the June/July CPUE.
    - Another option is to try to determine a minimal hydrology situation that will keep the population stable – this is particularly important in the drier parts of the annual cycle. If we can determine the bottom line that "holds" the

population steady even in bad years, that would be a huge success.

- Returning to the presentation, Mick shared that in the initial analysis the CPUE trend data was converted into a slope using two subsets of CPUE data to compare the general trends 1) from year to year for comparing annual trends, and 2) during late spring-early summer for recruitment trends. In the examples provided, there was a solid increase (slope of 10.6) in the population supported by a strong recruitment from May 2004 to July 2005. Remember, 2005 was the recent peak year.
    - The slope is the linear change (fitted line) between 2 points of CPUE data for comparison between years. For example, the October 2004 and the October 2005 CPUE data points are the ends of a line whose slope is calculated. For the 2005 example, the annual trend had a slope of 10.6 for October to October; and a recruitment slope of 49.4 for May to July. The idea is the spring hydrograph may affect the number of adult minnows (brood stock) from year to year, and the number of offspring from May to July.
        - The intent is to see how the flow changed the number of offspring. Basically, this is testing the hypothesis that the change between the May and July samples will be significantly greater for years with a deviation.
    - In the 2006 example, there is a negative trend slope due to natural mortality after the previous "boom" year in 2005. In this case, it is neither a good nor bad indication. But regarding recruitment, there was no detectable recruitment (i.e., there were more adults in May than young in July [but the presence of any young indicates some recruitment]).
    - In the 2011 example, there was some recruitment even as dry as it was. This was a no-action year. In terms of the recruitment, there was not quite replacement (of adults by young) but there was not a huge drop either.
        - PVA members provided feedback that the results for the deviation years (ex. 2008) would be interesting for comparisons.
        - ***Question:*** To what degree does population density need to be factored in? If there is potential for significant density dependence, doesn't that need to be understood and accounted for in order to determine what deviation impact (versus a density response)?
            - ***Response:*** Concur. The effects of density dependence need to be understood.
            - Developed growth rate information can be used to back-calculate the hatch day for an individual that is a few months old. However, there are complications with temperature. Unfortunately, the temperature is not constant where the minnow "hang out" so it isn't as easy for the minnow. The length of minnow caught in July could potentially be back-calculated to an approximate hatch date – for example, it might be possible to distinguish hatchlings from a May/June period or a late June/July period (i.e., from another event).

- Returning to the presentation, Mick explained that the results of analysis are intended help determine what direction the Corps needs to take the deviation. There are currently 3 options that the Corps can explore: (1) to pursue continuing the deviation – this would mean having sufficient justification in order to pursue changing the operations manual; (2) another approach could be to define an evaluation (or experimental) period of 5 to10 years during which time an AM approach is used to

refine what needs to be done; and (3) recommend "no continued action" if there is not enough data to justify moving forward at this point in time.

- ***Question***: If this "experimental" period reveals that more magnitude or duration of flow (or some combination thereof) is needed for a big difference in spawning success and recruitment, how much of that information can be transferred to actual operations? In other words, what is the implementation opportunity in terms of managing the water in the system during the spring season?
    - ***Response:*** That would depend on the year; but there it is likely that there will be some flexibility. For example, storage operations at El Vado influence what the rest of the downstream system. If the runoff is projected to be 3,500 cfs but brief/short, the operations at El Vado can be manipulated to a limited degree to dampen the peak slightly in order to "stretch" the duration.
    - When there is a certain supply, the timing of actions can be modified to benefit the system.
    - Right now, the deviation flex is pretty limited. If the action agencies are supportive and convinced in the value of the deviation, there would probably be an opportunity to explore more flexibility.
    - The prospect becomes more "palatable" for congress and managers if there is both storage and management pieces.

Hydrology/Hydrologic Inputs for the PVA

- The PVA work group revisited the hydrology discussion from Tuesday (yesterday) afternoon with a Reclamation representative present.
- The work group began by reviewing the EC directive from yesterday:
    - The EC directed the PVA work group to determine during the remaining May meeting time, what could be accomplished by June 15th in order to inform Reclamation's draft BA including the discussions on the baseline and proposed action(s) scenarios. The PVA work group was tasked to meet in early June in order to (1) review and discuss (internal review) of Dr. Goodman's *RGSM 2010 Revised Recovery Criteria in Relation to Population Monitoring Draft Report* dated May 1st, 2012 and (2) to discuss and resolve the incorporation of hydrology/hydrologic scenarios into the PVA models. The PVA work group should also determine what can be accomplished by the Service's August 15th, 2012 information deadline and meet as often as necessary to accomplish this.
- The PVA work group has never received the appropriate hydrologic scenarios that are needed. Right now, based on the content of the recent Draft BA, there are 5 10-year scenarios that were "strung together" to reach a single 50-year scenario that was run through URGWOM for a "no action" and "proposed action." Unfortunately, with only 2 scenarios, it will be very difficult to understand the "realism" or lack thereof of stringing sequences together to get to 50 years and the statistical and biologic issues that arise. The work group is still trying to wrestle with that and how to fit such scenarios into the PVA in such a way that the outputs would be realistic projections of the biologic importance of the sequences to the fish. Also, it is impossible to describe any differences between the "no action" and "proposed action" since there is such a small sample size and no error bars. In other words, there appears to be little or no statistical difference between the two and without error bars there is no way to statistically distinguish them. This means that there would be no way to distinguish any PVA outputs in terms of fish response either.
    - It was acknowledged that part of the limitation stems from the fact that URGWOM can only produce 10-year sequences (anything longer causes the model to "crash"). The

selection of the 10%, 30%, 50%, 70%, and 90% sequences also results in a lack of randomness for simulation in the PVA.
    - The PVA work group has lobbied for multiple 50-year runs since the beginning. Unfortunately, there is a resource limitation and 2 years ago, the PHVA work group was redirected to produce model runs for the BA. Thus their focus was shifted.
  - In order to inform the Draft BA, the PVA models need (1) hydrology sequences that define the (a) no action and (b) proposed action scenarios and (2) a collectively defined baseline.
  - The irony was pointed out that the PVA models are expected to produce biological outputs in terms of 100 years (ex. recovery criteria and risk of extinction) but they are only being provided 50-year projections created from 10-year hydrology sequences!
    - Concern was expressed that based on everything that has been discussed recently, the 2 months remaining are not enough to properly address all these issues. Part of the tension is that some people were under the impression that there was more time, but the Service has announced a shorter deadline than originally expected.
      - It will be critically important to interpretation of any biological outputs to have error bars on any provided hydrology – including the 2 sets that were incorporated in the Draft BA. Without knowing the uncertainty and scatter, it is impossible to state that there is a convincing difference between them.
      - The sequences need to have the variability accounted for. In an example, it was shared that if 2 cards are pulled from a deck of 52 and if both were clubs, would you state that the entire deck is thus clubs? Or is it the "luck of the draw?" The only way to prove or disprove, is to cancel out the "luck" by doing multiple draws (in this case, multiple runs).

- Attendees then discussed possible options for resolving the hydrologic component issue:
  - *PVA to use original dataset to generate the information they need:* it was asked if PVA could use the original dataset to generate whatever information was necessary.
    - This option was disregarded because the work group does not/will not have the information on the variability between the runs. If all the runs were provided, then yes, it would be possible to do the calculations of the statistical significance between the 2 hydrologic scenarios.
      - However, it was cautioned that the biologists would then be doing the hydrologists and Reclamation's work and time spend to do this would result in other tasks not getting done.
      - The PVA group would also be asking a lot of questions about the inputs being provided. The hydrologists need to express comfort (and confidence) in having the biologists do the statistical work.
    - It was also pointed out that the runs are selected so it still does not address the issue of *random* selection.
  - *Using the historic data (original ~6,000 synthetic sequences[?]), completely redo the hydrologic reconstruction:* Another suggestion offered was for the PVA work group to return to the paleo data and completely redo the hydrologic reconstruction to address the statistical issues from the beginning.
    - Unfortunately, there is not enough time. The work group would have to sacrifice other tasks and there are strict deadlines looming.
  - *Bootstrap analysis:* It was suggested that some sort of bootstrap analysis of the selected runs or even the ~6,000 synthetic sequences [?]could be done.

        - Concerns with this suggestion included: (1) everything would still have to be rerun through URGWOM; (2) climate change questions - 640 years of reconstructed paleo data contains information back into known historic episodes of changed climate so there would need to be decisions on how much of 640 years are actually representative of the current era; and (3) there would been to be a determination of variance for each stratum (10%, 30%, 50% exceedance, etc.) defined. This would require selecting several random draws are in the 10%/30%/50%/70&/90% ballpark to determine differences.
    - *Revisit Jesse Roach's monthly time-step model:*
        - Jesse Roach's 2009 paper detailed the work he had done. There were 1,000 synthetic sequences of 100 years in length. Unfortunately, this model was overly simplistic as it did not contain all the operational rules and the work group determined a daily time-step was preferable. *(Note: At the June 11th and 12th PVA meeting attendees were notified that Jesse's model does include monthly operations)*
        - Attendees briefly discussed the time-step flexibilities of each model. Dr. Goodman's model could be for a daily time-step if there were data. Dr. Miller's model is an annual time-step, driven by the data that is available for the fish; but there are some flexibilities.
    - *Run the 43 years of recorded water data through URGWOM to get to a rescrambling of the past:* In other words, have 43 single year runs.
        - It was pointed out that the last 40 years have been pretty wet compared to the variability in the cycle (ex. the severe drought in the 1950s.)
        - Because of the significant carry over from the one year to the next in URGWOM (due to reservoir storage) this option was disregarded.

- Dr. Goodman shared the opinion that at this point with the limitations of deadlines, the more severe problem is the absence of replication; the shortness of the sequences is problematic but the absence of replication is even more critical. If there were to be some replication, then the error bar issue becomes much more straight forward. Anyone who will be looking at these outputs (including the Service) is going to need to be able to tell the difference between the no action and proposed action scenarios. This will be central to any BO evaluation of the BA.
    - The PVA needs more replication of the 5 10-year runs – a different set of 5 pulling from the same stratum and running those through URGWOM. Ideally, there would be 100 10% exceedance sequences, 100 30% exceedance sequences, etc. in order to determine sample variation within a stratum.
    - There would still remain the issue of the length of the sequences (10 years) but the opinion is that that is less of a "show stopper" than the problem of the absence of error bars.
        - The explanations and descriptions of the process, inadequacies, and limitations should be documented as part of the reporting.
    - Some members shared that URGWOM has recently been revised so that it runs faster now and may be able to handle runs longer than 10 years.
    - PVA members assume that selecting the five sequences each closest to each of the 10%, 30%, 50%, 70%, 90% exceedances and running those through URGWOM to get to the variance (and error bar) question would take the least time of all the options discussed. It would address a very critical issue for both the PVA and the BA.
    - While the Program is frustrated that functional results from the PVA models have not yet been completed to inform the BA/BO process, the PVA work group is frustrated that they cannot effectively move forward (in terms of productivity) until the appropriate information has been provided. The PVA group has been asking for some of this

information for years now. The PVA work group also cautioned Reclamation that what is currently in the Draft BA is not statistically sound and not statistically useable.

- As of today, Reclamation itself does not fully know what the proposed action is comprised of since the state's contributions are not included.

- In response to the EC directive to provide information to Reclamation for consideration in the Draft BA (by June 15th), the PVA work group offered the following solution:
  - If Reclamation can select 5 sequences for each of the exceedance probabilities (10%, 30%, 50%, 70%, 90%) and run those through URGWOM for an additional 25 hydrologic scenarios to provide the variance information within each stratum, then the PVA work group could possibly have the hydrology component for the PVA resolved by August 15th.
    - (In other words, instead of having a single 10% exceedance example, select the 5 sequences closest to 10%/30%/50%/70%/90% and run all through URGWOM). This exercise will help to address the variance issue and determine the sample variation within a stratum.
    - If 5 runs for each exceedance cannot be accomplished within the month (by approximately June 15th), Reclamation was asked to determine how many could be completed. Even 2 additional runs per exceedance would provide an estimate of variance – which will be big but it could be used.
  - It was suggested that the modelers could provide the following by the June 15th deadline: (1) a "quasi-strawman" test run(s) using the existing 10-year scenarios; and (2) produce a memo or statement highlighting what appears to be the most significant conclusion or sensitive species response based on all the analysis, discussions, and experience of the models to date.

Resolution of Consensus data set

- PVA members discussed the resolution of the Consensus Data Set for this iteration of the PVA models. It was recommended that the work group consider and approve the data that are archived on Dr. Goodman's website. The documentation, quality control, and pedigree are all there.
  - In response, it was cautioned that the originators of the data need to be active in the process and "sign off" on the data being used. There needs to be a level of buy-in and acceptance from both the work group members as well as the contractors. There needs to be an opportunity to review and express agreement or disagreement with those data.
  - It was suggested that the group decision whether or not to include certain types of data into the estimation of the parameters due to differences in the model structures.
    - However, it was responded that the data should be kept separate from the parameter estimation because (1) the parameter estimation uses requires a lot of time to work through and it wouldn't be prudent to delay the data source resolution under that part of the matter is settled; and (2) since the models have different structures, they may not want to use the same parameter estimates. The consensus data needs to be settled and then the differences on estimates and methodology can be explored at a later date.
  - Dr. Goodman expressed that he is very leery of just accepting what is posted he has on his website without ASIR "signing off." Attendees discussed the need to reach consensus agreement without delay. As a compromise, it was suggested that a caveat and explanatory statement be put on the decision. Basically, the PVA work group would accept the data while acknowledging the multiple attempts to include the contractors in that decision.
    - Suggested ideas and language included:
      - *…The PVA work group accepts this data/these datasets with the acknowledgement that the originators did not contribute feedback or*

approval even though multiple opportunities to contribute and provide feedback and/or agreement on the datasets were offered.

- *The PVA work group is in agreement with using this data/these datasets that have been provided to date (most current). The background, collection methodologies, and intended use of the data has been thoroughly explained to the group and there is agreement with using these data sets as the consensus data for use in the PVA models for this iteration.*
- *The PVA work group accepts the population monitoring data as provided by the originators to Dr. Goodman and as reconciled by Dr. Goodman. The datasets and the pedigree are shown and documented on Dr. Goodman's website. The PVA work group requests the originators of the data review and concur with the validation or reconciliation of the population monitoring data.*

Use of Population Monitoring data as inputs to the PVA, to estimate demographic parameters for the PVA, and to validate PVA.

- Because this topic is related to Dr. Goodman's recovery criteria report, this discussion was postponed to the June meeting in order for members to review the report. The report that will be discussed at the June meeting as well.

FWS presentation on status of the ESA consultation, how PVA will or won't inform it, and the potential role of the RIP in the consultation.

- *Status of ESA Consultation*
    - The Service received the Corps' Draft BA in October 2011 and they responded by November 2011. However there is a consultation difference with the Corps that has no current path to resolution. Reclamation's incomplete Draft BA was received on May 7th, 2012. Additional feedback and communication will be provided in the next few weeks. The formal consultation process does not begin until the Draft BAs are considered complete. It is expected that Reclamation will submit another rendition, hopefully complete, by July 31st, 2012. Once the formal consultation begins, the Service will provide a Draft Biological Opinion to the action agencies. It will be up to them to distribute for Program review. The Service will then proceed with a revision period and issue a Final BO before the 2003 BO terminates on March 1st, 2013.
        - A "consultation difference" is a difference between a jeopardy and non-jeopardy opinion. A jeopardy opinion would mean another round in Washington, D.C. – which means more time.
        - It gets complicated because the expectation is to have a RIP – but the Corps prefers the RIP to be their RPA while Reclamation is looking to have the RIP be the conservation measure.
        - The RIP is established through the development of the LTP, RIP Action Plan, Program Document, and ultimately the signing of a cooperative agreement.
    - A PVA model was desired a long time ago to inform the Draft BA development by the action agencies and the development of the BO by the Service. The PVA charter contains 3 phases that outline the intent of the work group: (1) to support the BA/BO development; (2) support AM; and (3) support long-term recovery. That is the intended purpose for the PVA model(s).
- *How the PVAs will inform the consultation*
    - How the PVAs will or won't inform the process remains to be seen. Any information that the PVA work group has prepared to date will be considered. Any information that is prepared and submitted by July 31st and up to August 15th will potentially be considered. Everything else will be dependent on the situation.
- *Role of the RIP in the consultation*

- Reclamation would like the RIP to serve as the conservation measure to the proposed action.
- The Corps position on the RIP as an RPA was explained. Having the RIP as an RPA gives the Corps a better probably of funding that type of activity.
    - With the current BO, it took 5 years of justifying to both management and congress why the Corps needed the funding to meet the RPMS (in the BO) even though no specific actions for the Corps to undertake were identified. It was a lengthy process. The Corps has repeatedly informed the Service that have the RIP as an RPA would make the funding stream easier and more specific because actions/tasks for the Corps would be specifically identified. This increases the likelihood of being funding in a more timely manner after the BO is issued and helps to ensure a better continued funding stream. This is critical in light of the shrinking budgets. If there is a separate BO, it is even easier for the Corps to show "told this is what we have to do." The Service has not yet shown how this can be accomplished through a combined BO. The Corps is enthusiastic about doing the right thing but it has to be clear to headquarters (and the funding stream) what that is.
    - It was as collective decision by the program to purpose a RIP as a path forward since Reclamation will be unable to supply water (i.e., running out of supplemental water).

Introduction of RIP plans, potential role of PVA to establish RIP goals and Sufficient Progress Metrics

- Patrick Redmond handed out a document that he drafted explaining the RIP and the relationship to the PVA models.
    - The origin of the recovery approach came from August 2009 EC retreat. The 2003 BA/BO was designed to be a short-term compromise through a very difficult period with litigations. The flow-target orientation of the 2003 BO was designed to buy time. By 2009, the new consultation was on the horizon and the EC made the decision to take a more recovery oriented path instead of living year to year trying to make flow targets. By taking the recovery path, the entities in program felt they could set a more stable, predictable path forward that would eventually lead to down- and delisting. From 2009 to 2011 there was some talk/discussions but without much clarification or movement. Then late last year, there was a series of meetings to inform the EC what they had agreed on at the Taos Retreat; this agreement was that the motivating force behind the upcoming consultation.
    - The place of the RIP in the Program as a whole could be: (1) to provide the federal nexus allowing Reclamation to recruit all the other EC entities into this consultation and thus allowing the non-federal partners to be covered in the Section 7 consultation; (2) it becomes the governance body to administer and fund (or receive funding) for actions to promote recovery; and (3) it is designed as the conservation measure which sufficiently minimizes the impacts of actions on the species so the Service can issue a no jeopardy opinion. The RIP is the mechanism for committing the entities to perform certain activities that they have agreed to and the Service has concurred.
        - Without the RIP as the federal nexus, the BA(s) would be narrow - strictly describing the federal actions and the non-federals would have to decide which route they would prefer to take (ex. Section 10 or their activities sufficiently accounted for in the BO and covered through the incidental take statement).
        - ***Comment:*** Item #2 sounds like an ESA recovery team.
            - ***Response:*** Participation on the recovery team is completely voluntary. If the Program chooses to implement a RIP as part of proposed action or RPA element then they *must* do it or initiate consultation. Once a RIP is established and compliance is established through it, the agreeing parties either participate or reinitiate consultation.
            - A RIP can be independent of any BO, but since we are linking it to the BO it no longer becomes voluntary.

- *Sufficient Progress Metrics and PVA*
    - There has been a lot of discussion on the logic of using the PVA to inform the consultation process. However, while the logic on how PVA could be used to suggest or evaluate the sufficient progress metrics has been raised, it has not been discussed at all.
    - The RIP is a mechanism for committing the entities to perform certain activities or to achieve certain population levels, etc. Since there is not a regulation or statue regarding the RIP, there is no set formula. It depends on what the entities are willing and wanting to undertake and what the Service accepts as appropriate achievements meeting a threshold of jeopardy avoidance to offset the detrimental effects of proposed actions. But there are no "set" or standard requirements.
        - Generally, the RIP entity itself issues a regular (annual) self-evaluation to determine if the goals/milestones were met for the year and if they believe they are making sufficient progress. The RIP will send that self-evaluation to the Service for a concurrence. The Service has almost always concurred the RIPs making sufficient progress and thus avoided reinitiation of consultation. Ultimately, it is the Service that makes the decision regarding sufficient progress.
    - ***Question:*** How does the formation of the RIP and the moving forward thereafter differ from developing and implementing a recovery plan?
        - ***Response:*** A RIP is a higher level of commitment, has a governance body to administer and fund (or receive funding) for the activities, and develops action plans of some length (ex. 5 years) with annual work plans. Recovery teams serve as advisors on how to implement the different parts of a recovery plan; they have no regulatory or legal authority pertaining to actions. In a RIP, the signatories enter into agreement that has legal enforcement through Sections 7, 9, and 10.
        - Technical members on the recovery team can be invited to participate in the new RIP implementation teams. However, it was shared that the RGSM recovery team hasn't been convened in over a year. There intended purpose was to write the recovery plan. In fact, most members are no longer in the same positions or even in the state. The technical group for Big Bend has been active – since they have reason to be active.

- The technical issue presented now is what the sufficient metrics should be and what role will the PVA models play in formulating those metrics.
    - ***Question:*** What get "triggered" automatically if the Service issues an insufficient progress determination?
        - ***Response:*** That will need to be clarified or explained by the Service. The Service showed a simple diagram at the April 20th EC meeting that indicated that even with ups and downs over the years, as long as the overall trend is positive, then the activities are successful in keeping the species above critical thresholds.
        - An example with the Upper Colorado Program was shared. In 2005, a dramatic decline in the Colorado Pike Minnow was observed in conjunction with an explosion of small mouth bass. The Program submitted their evaluation letter and stated the problems identified with the declining population and the small mouth bass. The Service wanted to implement activities immediately to address the threat. Once implemented and in place, the sufficient progress memo went through. In other examples, additional mitigating activities are put into place as soon as an issue is identified. There have been times when the Service indicates that things have to be done before they will concur, but as soon as the program gets them done, then concurrence with the sufficient progress is issued.
        - Any violation of incidental take will result in a declaration of reconsultation. The RIP provides an "all for one" approach in that if one entity is having issues, then all

parties participate in the mitigation effort. This actually helps to avoid the reinitiation. Adjustments happen as needed throughout the year in order to avoid the "no sufficient progress" determinations.

- ***Question:*** How might the Service relate uncontrollable circumstances to make a jeopardy determination or to reinitiation consultation? What is the possibility that the species declines significantly even though the RIP accomplished its annual commitments and so the Service then says that the measures are not sufficiently effective? Will the criteria that the Program agrees to (with the Service included) be the only criteria that the Service uses to make a negative determination or will there be different levels of metrics? (In other words, are the criteria or metrics that the RIP establishes for itself all there is?) Imagine all the sufficient progress metrics are in compliance, could the Service still determine a need to reinitiate a consultation?
  - ***Response:*** The Service is currently being advised by their solicitor that the sufficient progress determinations are ultimately a Service decision. This process to determine metrics is a good one and will probably need to happen every few years to adjust accordingly and to make sure they are appropriate. Regarding reinitiation, there are standard reconsultation triggers that Reclamation and the Corps have to adhere to. Some of these are outside the control of the Program – for example, if the yellow-billed cuckoo gets listed, it would trigger a reinitiation regardless of sufficient progress determinations.

- PVA model outputs can be used to propose and validate indicators of progress (ex. evaluate whether or not hatchery releases are a good indicator of survival probability) and to even develop the sufficient progress metrics. PVA models can also inform the data collection and methodologies that need to be modified in order to be more appropriate or useful.
  - The analyses (ex. sensitivity analyses, aspects of fish biology that drive the dynamics, etc.) that the PVA work group has been doing can inform the current methodologies and scale of measurements.
  - The Service will look at whatever demographic information and data is available. Right now, that includes CPUE, some population estimation, some site occupancy, etc. PVA model outputs will be considered once available.
  - In examination of the sufficient progress letters/memos from other programs, none of them have a PVA model included so we are in new territory with this approach.
  - The PVA should also be run annually (updated with that year's data) to provide assurances to the Service that the species/system is doing fine. This yearly PVA output could indicate where the system "moved" relative to extinction risk and it can indicate if the species moved closer or farther from the recovery criteria. It can also indicate the probability of achieving expected recovery in a certain timeframe.
    - It was point out (regarding Item 1 #3 on page 1 - conservation measure) that assurance for both the Service and stakeholders comes through the RIP as a vehicle to facilitate the discussions and negotiations necessary to resolve the issue. This is a similar concept to the "no surprises" rule.
    - There is also more "power" than a single entity saying "this is not working" because there is a collective body of scientists and technical experts from all agencies making AM decisions on quick turnaround.

  - ***Question***: With the angst over the sufficient progress metrics, could the PVA models possibly be the only sufficient progress metric?
    - ***Response***: It might be a possibility; it is at least a worthwhile question to ask if the PVA models can be done with an acceptable level of uncertainty in the end result,

should any other metrics be relied upon? In other words, if the statistical analysis of PVA is much higher quality, why use the less "good" indicators of species health.

- It was pointed out that the logic applies to the response metrics but not to compliance metrics. A promise is a promise. If the RIP has committed to a specific activity or a species response, they are obligated to fulfill that promise to the best of their ability. This is where AM should play a large role in determining what is working and learning how to modify it to make it work better. AM will be the difference between a successful and unsuccessful RIP.
    - When discussing an AM experiment, the commitment to do the experiment is the promise and the commitment to do the necessary monitoring and revisit the situation accordingly. It is not a promise to continue forever.

Next meeting and deadlines

- Attendees then discussed possible dates in June for the next PVA meeting.
- It was agreed that the week of June 11th was a reasonable timeframe to balance the need to sufficient time to get actions accomplished before the June 15th deadline.
    - After further discussion, it was agreed that all day June 11th and June 12th were the best days to try to accommodate a majority of work group members and the modelers.
    - Attendees then discussed what needs to occur between now and June 11th:
        - 1) Work group members are to read and "digest" Dr. Goodman's *Revised Recovery Criteria in Relation to Population Monitoring Draft Report;* and
        - 2) submit comments, discussion points, and questions on the report in advance of the June meeting to facilitate those discussions;
        - 3) the modelers should do a "quasi-strawman" test run(s) using the existing 10-year scenarios;
        - 4) the modelers should produce a memo or statement highlighting what appears to be the most significant conclusion or sensitive species response based on all the analysis, discussions, and experience of the models to date;
        - 5) work group members are to review the datasets on Dr. Goodman's website to prepare discussion points, questions, and identification of anything that needs validation or review in preparation for the Consensus Dataset decision at the June 11th meeting. Feedback should be emailed to David Gensler and Dr. Goodman no later than May 31st, 2012 in order for a simple yes/no decision to occur at the June meeting;
        - 6) the modelers should prepare a memo to address each question (that was provided by the EC) and identify what information would be needed in order for the PVA models to provide "good" outputs; and
        - OPTIONAL/FUTURE: 7) if possible by June, modelers could possibility address some of the Service questions (#1-#5) by running the preliminary model if some basal level of flow information/hydrologic profile were to be provided in time;
        - OPTIONAL/FUTURE: 8) once an appropriate hydrology sequence for the no action and proposed action scenarios have been provided, use the results from the PVA models to demonstrate in part if those sequences need additional detail/work/revamping/etc.
        - OPTIONAL/FUTURE: 9) at some future point in time, discuss the Bayesian elements/approach to uncertainty in the FORTRAN PVA model; and
        - FUTURE: 10) address the bifurcation (differences) of the PVA models sometime between June and August. It is assumed that the preliminary work being done now and the preliminary outputs will look fairly similar for both models for the next few months, but they are expected to diverge later in the future and this will require explanation to the audience.

PVA Meeting Attendees
May 14th, 15th and 16th, 2012

NAME	AFFILIATION	PHONE NUMBER	EMAIL ADDRESS	Date		
				05/14	05/15	05/16
David Gensler	MRGCD; Co-Chair	505-247-0234	dgensler@mrgcd.com	✓	✓	✓
Dr. Daniel Goodman	Specialist – MRGCD rep; PVA Modeler	406-994-3231	goodman@rapid.msu.montana.edu	✓	✓	✓
Dr. Phil Miller	IUCN-CBSG	952-997-9800	pmiller@cbsg.org	✓	✓	✓
Rick Billings	ABCWUA	505-796-2527	rbillings@abcwua.org			✓
Mick Porter	COE	505-342-3264	michael.d.porter@usace.army.mil	✓	✓	✓
Lori Robertson	FWS	505-761-4710	lori_robertson@fws.gov	✓	✓	✓ (pm)
Jennifer Faler	Reclamation	505-462-3541	jfaler@usbr.gov			✓ (am)
Grace Haggerty	ISC	505-383-4042	grace.haggerty@state.nm.us		✓	
Stacey Kopitsch	FWS	505-761-4737	stacey_kopitsch@fws.gov	✓	✓	✓
Yvette Paroz	Reclamation	505-462-3581	yparoz@usbr.gov			✓
Rich Valdez	SWCA/ISC	435-752-9606	valdezra@aol.com	✓	✓	✓
Brooke Wyman	MRGCD	505-247-0234	brooke@mrgcd.us			✓
Jason Remshardt	FWS	505-342-9800	jason_remshardt@fws.gov	✓	✓	✓
Patrick Redman	MRGCD General Council	505-346-0998	pr@lrpa-usa.com	✓		✓ (pm)
Peter Wilkinson	ISC	505-827-5801	peter.wilkinson@state.nm.us	✓	✓	✓
Janet Jarratt	APA	505-620-1136	jj@jjwater.info	✓		
Gina Dello Russo	FWS	575-835-1828	gina_dellorusso@fws.gov	✓		
Christine Sanchez	Tetra Tech	505-881-3188 xt 136	christine.sanchez@tetratech.com	✓		
Marta Wood	Tetra Tech	505-259-6098	marta.wood@tetratech.com		✓	✓