Upper Colorado River
Endangered Fish Recovery Program

January 25, 2010

Biology Committee Draft Summary
Grand Junction, CO, December 13-14, 2010

Biology Committee: Melissa Trammell, Dave Speas, Michelle Shaughnessy, Pete Cavalli, Krissy Wilson, Shane Capron, Tom Pitts (via phone), Brandon Albrecht, and Sherm Hebein. CREDA was not represented.

Other participants: Harry Crockett (will be replacing Sherm Hebein on the Biology Committee), Matt Breen, Paul Badame, Matt McKell, Steve McCall, Boyd Clayton, Dean Riggs, Pat Martinez, Tom Chart, Tom Czapla, Angela Kantola. By phone: Mike Roberts, Kevin Bestgen.

Assignments are indicated by ">" and at the end of the document.

Monday, December 13

CONVENE: 1:00 p.m.

1. Review/modify agenda – The agenda was modified as it appears below.

2. Yampa River water quality – Dave Brown, USGS, called Tom Chart about establishing a long-term water quality monitoring station on the Yampa. BLM and NPS have initiated the interest. Concern has been expressed about potentially increased iron levels, as well as a long-term gradual increase in pH. Melissa said USGS has conducted this monitoring for several years, with NPS funding half and CRWCD the other half (CRWCD dropped their funding last year). They currently fund 4 samples/year @ $2,500/sample, but would like to fund 8 samples/year. The Biology Committee supported the concept, did not believe the Program has funds to offer at this time, but will reconsider when developing the FY 12-13 work plan. Mike Roberts suggested seeking funding from EPA's Healthy Watershed Initiative. Barb Osmundson mentioned tracking endocrine disruptors to Dave Brown, but those are outside the constituents USGS generally monitors.

3. Aspinall study plan – Tom Chart introduced the plan, which is a requirement of the Gunnison River PBO. An ad hoc committee began work on the plan this summer, and Dave Speas provided a first rough draft. It takes the same approach as the Green River Study Plan, but we have less baseline information in these Gunnison/Colorado reaches. Tom Chart noted that Brandon had asked for better maps to help locate place names; Tom didn't find a good map, but tried to add more description to help the reader recognize locations. Tom also revised the draft to refer directly to the proposed action. With regard to comments from CREDA, Tom addressed their comment about the proposed action, but thinks the Management Committee will need to address the ramping rates concern. Shane said Clayton will have some concerns at the Management Committee. Throughout the plan, the language seems to indicate that if we find out we're not doing enough for the endangered fish, we'll see what more we need to do. Shane suggested taking a broader view, for example, if we're doing something that's marginally effective, but very expensive and we learn that we can do

something that is significantly more beneficial, we'd want to make that adjustment. Shane recommended using language that more clearly indicates we're evaluating effectiveness and modifying our actions based on whatever information we gather. >Shane will provide suggested text changes. Dave Speas said the document seems technically sound, but needs a careful editorial review. Sherm asked about quantifying uncertainties. Dave Speas suggested that the timeline and the RIPRAP tables look pretty similar and wondered if both are necessary. Dave may provide some specific comments on Table 4 (e.g., making it clear that we want to repeat aerial photography in outyears, timeline for temperature work, etc). Dave noted that the related questions (page 32) on fine sediment and primary productivity are ranked differently in different parts of the document (UG1 in Table 1 ranked high, on page 32, ranked medium). With regard to the ramping rates, the plan identifies these as policy issues, with a footnote referring to section 2.4 (might also refer to page 6). Tom Pitts suggested that in the discussion related to the RIPRAP, we need to include the caveat that these items will be considered in the context of overall Program priorities. >Committee members should submit any additional detailed comments no later than January 14 (earlier, if possible) to Tom Chart and Angela Kantola and the rest of the Biology Committee. >The Program Director's office will incorporate those comments and do a thorough editorial review, then submit the revised plan to the Management Committee for their review/approval by the end of January (with Management Committee members preferably providing specific written comments IN ADVANCE of the February 16 Management Committee). >Tom Pitts will send the draft document to the water users and incorporate any of their comments with those he submits by January 14.

4. Tusher Wash – Tom Czapla described the ad hoc group's review of options (Attachment 2), noting that we don't yet know if the water users plan to change the elevation of the diversion, or divert more water from river left. Melissa Trammell said current mortality through the turbines is the most significant uncertainty; if higher than the 50% we've assumed, then any screening option will be a significant improvement, but if less than 10%, then screening the turbines may not be needed. The ad hoc group reviewed various screening options and Kevin Bestgen's estimate of mortality of adult and sub-adult Colorado pikeminnow under each of those options. Kevin also looked at how the various options would enhance our ability to achieve the recovery goals (note: these do not consider other sources of mortality). Kevin said another important assumption is that a pikeminnow only encounters the diversion once per year, and we expect many of the fish have at least two encounters each year (and other fish may have no encounters). Shane cited examples on the Columbia River, emphasizing the importance of correctly analyzing the impact of percent mortality over time with repeated encounters. Part III of Kevin's analysis gets at population-level effects over time for different options. Dave Speas discussed the differences between options 1 and 3. It appears that we would do better to spend a little money rather than a lot (and this would be better than doing nothing). With regard to option 2, Bob Norman said it would cost about the same for options 2a and 3. Kevin said the differences in mortality between options 2 and 3 would be negligible if you assume that fish that go down the canal and then get sent back to the river suffer only 10% mortality. Overall, the screen would have the most impact in drought years (which is when fish are under the greatest stress and most need improved survival). Tom Pitts said he's not comfortable deciding to spend millions on a screen until we establish the current mortality rate. Brandon asked about larval fish, noting we haven't

really quantified potential impact to that life stage. Melissa commented that only the full screen would screen larval fish, saving larvae lost down the irrigation canal. The Committee wondered how much power is generated for what purposes and if the owners might consider full or partial decommissioning. Bob Norman said he thinks we might still be able to pursue this, and said he thinks the owners' expectations for power generation may be higher than what is realistic. The power plant currently generates 2.5 million kilowatt hours per year (generating $75K/year at 3 cents per kilowatt hour minus operating costs). Bob has talked to the companies that make "fish-friendly" turbines and has learned that the two runners in the hydro plant are Leffel propellers, which probably aren't bad in terms of fish mortality; on the contrary, the one on the pump is a "Francis" design that may cause more mortality. Melissa reviewed the ad hoc group's recommendations:

- *Review the literature for appropriate study design and asking/answering the right questions.*
- *Do the mortality study through runners and determine what improvements could reduce fish mortality (visual inspection of the runners).*
- *Screen the 100 cfs for irrigation (option 3).*

Tom Chart suggested that an engineering feasibility component be part of the mortality study, as it will be critical to learn how much survival can be improved under the various scenarios. The Biology Committee recommended >starting with a literature review (there may be good information from low-head structures in the eastern U.S.); working on outlining what would be needed in a mortality study (including engineering considerations); and further investigating whether the owners would consider full or partial decommissioning.

5. Report review: #138 (Final draft sent to BC from Badame 11/23/10 – Paul Badame described the history and the shift in this report to a 25-year summary. Melissa provided additional specific comments and noted the literature citations were pretty light. Since the peer reviewers frequently asked why more analysis wasn't done, Melissa suggested explaining in the text the analysis that is being done by other projects (e.g., backwater synthesis). The Committee suggested the report needs a thorough editorial review. Melissa asked why so little information was included on other species, and Paul replied that information collected too sporadically to include in a meaningful way. Dave Speas suggested adding a recommendation to consistently collect these data in the future. Tom Chart said he thinks it's incredibly important to continue this sampling and maintaining this long-term dataset. Dave Speas commented that many of the recommendations call for further investigation and asked if those refer to this study or others. Paul said at least the first three fit easily into the work Kevin Bestgen is doing (meta-analysis). Paul suggested the recommendations should focus more clearly on what should/shouldn't change in the sampling protocol and that recommendations for further investigations that are already underway should be deleted. > Paul will revise the report according to comments offered today and any additional comments >offered by Committee members within 2 weeks and get the revisions back to the Committee by February 1. The Committee will need to look at the recommendations again before approving the report (preferably at the next meeting). Pat Martinez commented on this time series showing the shift to other species. If this shifts the food web, the problem is magnified; therefore, Pat suggested something along the lines of Phaedra Budy's isotopic work on the San Rafael (as reported at DFC last month); >Pat will

provide suggested language to Paul. Suggestions for any changes should be *in addition* to the current protocol, so that nothing is lost.

6. Research framework procedural review – Tom Czapla reviewed the summary of comments from the environmental groups, UDWR, and USFWS, as well as recommendations/options for how to proceed:

   Recommendations / Options:

   - *Considering recent actions (synthesis efforts, 5-year reviews, Aspinall Study Planning) is there still a need to pursue the Research Framework? If not, the Program Office could incorporate the specific comments received to date into a final draft by the end of February.* Dave Speas asked if these projects are referenced in the current version of the research framework and Kevin said he thinks they are. Tom Chart said the three synthesis efforts are cited, but not the Aspinall Study Plan or the 5-Year Reviews. Mike Roberts suggested the level of specificity about these efforts was very general. If we go this route, the environmental groups would like to offer a few specific comments, which they've refrained from doing to date.
   - *Expend some more time to develop the literature review / database component to provide better justification for the Research Framework recommendations.*
   - *Recovery Program collaborates with TNC through their Conservation Action Plan. We should review the San Juan River product (perhaps TNC has others that might be more pertinent to our Program) to get a sense of expected outcomes.* Mike said this may or may not fit, as it has a slightly different intent, but he believes it could be modified to meet the Program's needs. In any case, the environmental groups would like to see some sort of Phase II effort that synthesizes the syntheses. Tom Chart commented that the Program reviews accomplishments annually and asked if something more detailed is needed. Michelle Shaughnessy commented that this is exactly what a 5-Year Review is intended to do.

   Brandon said he's given this report considerable thought and really appreciates the difficult challenge the authors had in trying to hit a moving target. Brandon's sense was that this project was intended to describe where we're at, what we know/think we know, and what do we need to do. Brandon asked the Committee if we feel this has been useful, should we continue, and should we promote this kind of effort. Mike observed that we all work on what's most important to us and this research framework doesn't seem to have risen to that level for most of the Committee. Mike commented that the synthesis reports and the Aspinall Study Plan are really close to what they'd hope to see: laying out hypotheses, identifying studies to address them, and then placing that in the framework of the RIPRAP. Mike and Brandon have discussed whether it would be good to undertake an effort to synthesize all these syntheses, and would like to know how the Biology Committee views that. Tom Chart says he's open to a next-level effort and the insights that could bring, but he, too, is trying to understand how it will help the Program. The Committee agreed that >any additional comments should be provided to the Program Director's office (and the Committee) by January 15 (four weeks was allotted in recognition that the Biology Committee *is* the peer review for this work and Biology Committee members very much

need to provide a substantive review). The Committee decided to pursue the first option (complete the document), and then consider the next steps at the time they review the final draft. It will be helpful for folks to see the 5-Year Reviews and see what those offer (though they may not have the level of detail folks are looking for, in the future, they certainly could reference the more detailed documents). >Tom Czapla will immediately provide a copy of the July version, a working link to the database referenced in the draft report, copies of the comments submitted to date, and a bold, uppercase reminder of when Committee members comments are due (January 15).

7. Floodplain updates
    a. Fall sampling results – Michelle Shaughnessy said they sampled Thunder Ranch and Johnson Bottom this year, found no endangered fish, and mostly nonnatives (this is discussed in the Baeser annual report). Remaining funds were spent to capture as many fish as they could from Baeser this fall and sample Thunder Ranch and Johnson Bottom.

    b. Baeser – Michelle Shaughnessy outlined the revised SOW that closes out Baeser by capturing as many fish as possible, and then allows it to reset (after which, in 2012, it could be a potential location to stock bonytail). The cost may go down just a bit more in light of Federal salary freeze. The Committee approved the scope of work.

    c. Stocking locations for Wahweap bonytail – Krissy Wilson said the re-test for largemouth bass virus (negative, fortunately) meant they couldn't stock bonytail from Wahweap this year, so they are being held over and Utah would like to consider alternative stocking locations (e.g., floodplains) to increase survival. They will have ~25K bonytail ready to stock this spring. Melissa mentioned Iceberg Canyon, but in light of NPS regulatory review, this possibility is a few years out.

8. Other updates

    a. Maybell Ditch sampling for 2011 and 2012 – Dave Speas is preparing a SOW from Peter McKinnon's report. A Yampa River landowner near Maybell is willing to grant access for a PIT-tag reader in the Maybell Canal. Ambient electronic noise analysis results were a bit ambiguous at first (the site is right under a power line), but Peter believes he's now found an adequate site for a hybrid PIT tag antenna (with the bottom half portion attached and the top allowed to pivot with flow to avoid debris problems). The system will be installed this spring and John Hawkins will periodically download the data (a satellite uplink would be prohibitively expensive). Tom Czapla asked if we know what portion of the Colorado pikeminnow population in that area has been tagged. Kevin Bestgen likely can answer this question.

    b. Price River flow recommendations/position paper – Tom Chart said an RPA in the Narrows BO directed FWS to build on Cavalli's work and develop a flow

recommendation. The Walker 2007 baseflow recommendation was for 53 cfs. Tom said the Program Director's office looked at historic flow conditions and arrived at a slightly lower "keep it alive" flow level. Tom has discussed this with FWS and UDWR, the Service asked for a small modification, and >the Program Director's office will make that change and get the document to the Committee within the next week, with comments due a month later. Dave said the expected date for completion of the Narrows EIS is several months out (~600 comments were received). UDWR will submit a scope of work to Reclamation under 'activities to avoid jeopardy' for some stationary pit-tag readers in the White River.

ADJOURN 5:20 p.m.

Tuesday, December 14

CONVENE: 8:00 a.m.

9. Schedule next meeting –The Committee scheduled a web conference for January 24 from 8:30 a.m. to 11:30 a.m. and 12:30 p.m. to 2:30 p.m. to review: a) the nonnative fish briefing paper; and b) revised nonnative scopes of work (PI's and scope of work managers will meet after the researchers meeting to discuss revisions to nonnative fish management scopes of work; Pat Martinez will try to attend also.). The Committee scheduled their next meeting for March 1-2 at the Clarion in Grand Junction (1 p.m. to 5 p.m. on March 1 and 8:30 a.m. to 4:30 p.m. [possibly later, so Committee members are asked to make travel arrangements, accordingly] on March 2). Agenda items will include: a) review of draft RIPRAP assessment, draft revised RIPRAP and draft FY 12-13 Program Guidance (will be sent out by the Program Director's office for technical committee review on February 1); b) nonnative fish management activities (including CDOW "bucket list"); c) final review/approval of UDWR's #138 report; d) review/approval of revised research framework report; e) review of proposal to evaluate fish survival in GVP screen fish return (unless discussed during January 24 web conference; f) discussion of Flaming Gorge spring and base flows; g) implications of recent humpback chub genetic results for Yampa River humpback chub captivity plan.

10. Nonnative fish workshop – Pat Martinez reviewed recommendations from the nonnative fish workshop (See Attachment 4, which includes Committee comments and assignments shown in italics). Pat Martinez outlined why he views the current scenario at Elkhead as such a serious problem, one which is likely to worsen as smallmouth bass reach carrying capacity in the reservoir (Attachment 5). Dave said he thinks this provides the necessary rationale to stop translocation into Elkhead Reservoir until research indicates the level of escapement is not impeding recovery efforts; others agreed. >To inform discussion at the February 16 Management Committee meeting, Pat will draft Attachment 5 into a briefing paper addressing recommendations from the recent nonnative fish workshop that differ from the 2010 status quo (see CDOW position, below). The outline/draft will be worked on by the subcommittee, then come to the Biology Committee for review during their January 24 web conference. Tom Pitts suggested including background about current permit conditions and any agreements made regarding maintenance of the Elkhead fishery. Tom Chart agreed, and

recommended including language from the Yampa River PBO, as well. Melissa suggested including language from other relevant documents, such as the Nonnative Fish Stocking Procedures, Policy, sufficient progress letter, etc., also. Melissa said the Committee has tried to help Colorado substantiate the need to stop translocating smallmouth bass into Elkhead Reserrvoir as best as possible. Sherm said he and other CDOW personnel provided several recommendations regarding Colorado's participation in the Recovery Program to their Director three weeks ago. They were not successful in getting any of those accepted. Instead, the Director indicated that for 2011, CDOW will accept the status quo from 2010, including post-spill translocation of smallmouth bass >10" from the Yampa River to Elkhead, translocation of pike from Yampa to Kyle's Pond (none to Yampa SWA or Loudy-Simpson), all of which will be conditions of the 2011 collection permits. On the White River, all nonnatives will be lethally removed. On the Colorado River, any largemouth bass >10" would go to Highline lake (none found to date), all other nonnative fishes lethally removed. Tom Pitts asked if CDOW would provide this in writing, but Sherm said they haven't received it in written form. Tom Chart said the Program partners have outlined a biological, technically-based rationale for the recommendation to stop translocating; therefore, he believes Colorado needs to provide a biological, technically-based rationale for rejecting this recommendation. Sherm said the CDOW representatives here today understand the technical basis, but are conveying CDOW's position of 2010 status quo for 2011. CDOW's Director and Steve Guertin have discussed a seeking a complete, independent review of the Recovery Program (and perhaps beyond). Tom Pitts asked what this review is about and suggested that >CDOW and the Service offer considerably greater transparency to the rest of the Program partners about the objectives and desired outcomes regarding such a review (at least by the time of the February Management Committee); others agreed. In summary, the majority of the Biology Committee recommends ceasing translocation into Elkhead Reservoir at this time, with Colorado unable to support that recommendation (thus, >Colorado should provide a minority report outlining the technical basis for their position). Sherm Hebein said Harry Crockett now replaces him on the Nonnative Fish Subcommittee and on the Biology Committee. The Committee recommended that the >Nonnative Fish Subcommittee discuss and distill workshop recommendations before they come to the Biology Committee in future years (and the subcommittee should spend more time with the recommendations beyond what the Biology Committee did today).

11. Green River spring flows – Matt McKell described UDWR's proposal for a spring flushing flow request to benefit trout: at least 8,600, up to 9,400 if conditions allow, for 5-7 days in 3 of the next 6 years, then once every 5 years after that. >Dave Speas will talk with Heather Patno about the best way for Utah to make this proposal. Krissy said UDWR wants to work within the process, whatever that is. Tom Chart said he thinks the Recovery Program could probably support something like this and it can be compatible with flows for the endangered fish. Based on the draft floodplain synthesis work, it will be important to time this with larval light-trap collections. Because the floodplain synthesis is still in draft, it makes sense for the trout concerns to lead this recommendation, with support from the Recovery Program. Matt emphasized that this is a *draft* proposal to improve the quality of the trout fishery and they're seeking input from the Biology Committee and others. Dave asked if UDWR has discussed this with Brown's Park NWR, and Matt said not yet. Melissa said the data suggest flows >10,000 are needed to meet some of the Park's objectives, but >she will see if they can

support UDWR's proposal, nevertheless. Melissa did suggest that it might be good if Utah's proposal indicated they would not be opposed to even higher flows, and that the timing is open. >Krissy will send Matt's presentation to the Biology Committee.

12. FY 11 work plan update and discussion of any other new/revised SOWs – Angela Kantola gave a quick review of FY 11 contingency projects. Michelle discussed the scope of work outlining alternatives for evaluating fish condition below GVP fish return. Costs range from $35.8K to $18.8K, with the more expensive option covering all seasons, conducting health condition profiles on control fish and fish that have gone through the passage, and evaluating the number of endangered fish going through the passage. Michelle recommends option 2 or 3 at this time. If funds weren't limiting, Dave Speas recommends option 1. Michelle said Patty Gelatt thought any of the alternatives would work. >Michelle's staff will spend more time with this scope and get it (and a recommendation for which alternative they think would be best) back to the Committee for discussion during the January 24 web conference.

13. Propagation activities (Czapla, 15 min)
    a. Humpback chub genetics and captivity plan *(see September 28-30 meeting summary)* – The Committee will discuss potential next-steps at their next meeting.
    b. Dexter NFH will be doing a broodstock review (need for back-ups) in a meeting scheduled for February 16 at Dexter.

14. Approve Biology Committee September 28-30 meeting summary – The summary was approved as written.

15. Review previous meeting assignments and reports due list. The Committee did not have time to review assignments, but >Committee members will review the list and take necessary actions. >A number of reports are behind schedule and this needs to be addressed. Committee members/PI's will review the reports due list and provide updates or revised due dates to Angela, as required.

ADJOURN 12:45 p.m

Attachment 1: Assignments

1. The Program Director's office will work with CDOW and Aaron Webber on the potential for designing a permeable, hydrologically-stable (gravel?) berm to prevent northern pike access to the oxbow slough at RM 151 on the Yampa, and then clean it out once and for all. *10/30 CDOW has contacted the property owners of the RM 151 backwater, but hasn't been able to meet with them yet. Mark Wernke from Reclamation is willing to take a look at the property with CDOW. A fairly long berm would be required (>3,000') and we'll need to determine the best type (more permanent configurations could be very expensive). The funding source would need to be determined, with Partners for Fish and Wildlife, lottery funds, grant funds, etc. as possible sources to be explored. 1/15: Tom Nesler said they plan to get engineers develop specs/estimates this spring for something like a 10-year berm structure; the next step will be to find fun2ding (perhaps as a habitat project through GOCO). This would be the first of three or four such projects. Tom Pitts suggested that if the Program provides some matching funds (annual or capital), it might improve the probability of getting GOCO money. Tom also suggested that if we have a project in the hopper, we might be able to compete for end-of-year Reclamation funds. 2/10: The PD's office considers this a high priority and will contribute funds, if available (see revised FY09 budget). 2/20: Recovery Program funds likely available; CDOW working to get engineers on the ground; Nesler considering different approaches (berm, fill the oxbow, etc.). 4/20: Tom Nesler said they've met with the landowner and Reclamation engineers will do an onsite survey as soon as the snow melts. 1/5/10: Project deferred indefinitely; Reclamation cautions that the lesson from the Butch Craig floodplain site is to be very cautious before considering modifying habitats. Based on the channel dynamics in this area of the Yampa River, it would be unwise to construct an impervious dike at the mouth of this backwater. 1/14/10: The Committee discussed other options to eliminate spawning in this area; the >PD's office will provide Mark's trip report to the BC and work with CDOW to outline options for Committee discussion at the next meeting (options could include: make the entrance too shallow for adults; a dike set back instead of right at the river; direct removal/net sets; piscicides, etc.) 2/22: PD's office provided Mark's report. 3/10:* ***CDOW*** *will work with Reclamation to flesh out their gravel proposal and also will review additional options (e.g., plant eradication, barriers, etc.). This will be on the May 6-7 Committee agenda. 5/6/10: Sherm Hebein said Reclamation will conduct a site visit with CDOW in July. 8/18: Sherm hopes to schedule a visit after the landowner cuts the grass in the next 2 weeks.*

2. Within the next month, >the **Service and Program Director's office** will provide the Committee a draft addendum to the White River report that will present the measured flow requirements in a historical hydrologic perspective. The Program Director's office also will research where we left Schmidt and Orchard's draft report on peak (channel maintenance) flows and recommend whether to have it reviewed by the geomorphology panel. The Program Director's office will use the information currently available to >develop a position paper on Price River flow recommendations for Committee review. *10/16 Pending; out by the end of ~~November~~ 1/5: February 2009. 2/20: Bob Muth said he's making good progress on this and he'll have a draft to the Committee by ~~early March~~ end of April. 7/8: Mohrman and Chart expect to provide drafts of this and Price River report by the end of August 2009.*

7/13: Dave Speas said the goal for the Narrows EIS is to get it out for public review in the fall, so the above schedule should work. The PD's office will keep the Service's SLC-ES shop in the loop on Price River. 9/21: Chart and Mohrman have made good progress on this, but other priorities have so far prevented completion. 1/14/10: still pending and the PD's office will continue to communicate with Reclamation re: Narrows. 3/3/10: PD's office is communicating with SLC-ES to determine the best way to move this position paper forward. 5/6/10: The Program Director's office will complete a position paper (or similar construct) on Price River endangered fish flow needs and submit it for Biology Committee review by September 1, 2010. The Program Director's office will complete the addendum to the White River report and provide a status update and recommendation on the draft Schmidt and Orchard report on peak (channel maintenance) flows for Biology Committee review by December 31, 2010. 12/13 Price River discussion: The **Program Director's office** will revise the draft Price River position paper and get it to the **Biology Committee** within the next week, with comments due a month later.

3. *Melissa believes an Environmental Assessment of the impacts of the Humpback chub captivity management plan (also addresses how to deal with captured roundtail chub) will need to be written;* Krissy will work with Melissa on the EA. *7/13: Melissa needs to coordinate with the NPS if this is the case and she intends to do that in the next few weeks. 10/6: John Reber reported that **Melissa Trammell** will do the EA for this. 5/6/10 Melissa said she would have a draft for the park by ~~the end of May September 6~~.*

4. The **PD's office** will communicate with Gary White to determine how many and which of the questions from the HBC workshop to focus on. *Pending.* **Derek Elverud** will provide the database for Westwater for Gary White to combine with Black Rocks, which will require a separate SOW. *10/6: **Travis Francis** said they plan to complete the reports, then revisit a SOW for assistance from Gary White. 3/10: pending. 4/28: Derek Elverud has finished compiling the Westwater data to send to Gary White. Travis Francis is going to combine his Black Rocks data set with the Westwater data and his report (when he has time after he gets out of the field). 8/18/10: Michelle said we can get this to Gary White this winter.*

   The **Program Director's office** will prepare a list of issues to be resolved regarding Tusher Wash screening (e.g., what levels of mortality are acceptable for what size classes, potential O&M costs, etc.) to help move this decision forward (and provide that to the Biology Committee and the Service). *Done. 5/6/10:* **A small group (Melissa, Kevin McAbee, Dave Speas, Tom Pitts, and Tom Czapla)** will work with **Kevin Bestgen** to review/build on the risk assessment, focusing on understanding existing impacts and what could be gained by various screening options. Tentatively, it would seem the best choice would be fish friendly runners with a screen on the irrigation ditch (contingent on further analysis). *BC to submit proposal to MC by 12/31/10. 11/23: Conference calls held 11/10 and 11/24 and scheduled for 12/2. 12/13 BC discussion:* The Biology Committee recommended >starting with a literature review (there may be good information from low-head structures in the eastern U.S.); working on outlining what would be needed in a mortality study (including engineering considerations); and further investigating whether the owners would consider full or partial decommissioning.

5. **Michelle Shaughnessy** will provide cost comparisons for O&M of the proposed new Grand Valley fish rearing ponds versus existing ponds as soon as the value engineering study is completed. *Pending; Michelle anticipates ~$30K increase in total costs (primarily fish food). 8/18: Current est. is an increase of $30K to the FY 11 SOW. If a new vehicle is needed, another $11K would be needed. All of this will depend on actual construction/completion dates.*

6. The **Program Director's office** and **Kevin Bestgen** will work with **PI's** to identify sampling shortcomings and remedies for Green River Colorado pikeminnow population estimate and report back to the Biology Committee prior to the 2011 sampling season. *Pending.*

7. The **Program Director's office** will post the revised 2008 and 2009 nonnative fish workshop summaries to the web. *Done.* **Dave Speas** is working to tabulate the recommendations from the 2008 and 2009 workshops and outline how to implement them and the NNFSC will meet to discuss this on June 30. *Done.* In the future, the **PD's office** will quickly complete these workshop summaries and the recommendations included as part of the annual and final report summaries. *11/23: Recommendations being incorporated into basinwide nonnative fish strategy; workshop summary will be made available soon after Nov. 7-8, 2010 workshop.*

8. The **Service** (**GJ-CRFP** and the **Program Director's office**) will make recommendations for how/where to manage the fish spawned this year at the Grand Valley facility and bring those back to the Biology Committee. *8/18: Will be discussed during the health condition profile meeting. The **PD's office** needs to schedule discussion//revision of the integrated stocking plan. 9/30: >**The PD's office** will set up a work group for revising the propagation plan (Krissy and Michelle will assist).*

9. The **Biology Committee** will work on prioritizing their list of potential additional capital projects at a future meeting. *Ongoing.* By September 22, **Committee members and others** who suggested capital project ideas will provide short explanatory/descriptive text (preferably just a paragraph), and then the **Committee** will decide when to take the next steps (individual ranking, group discussion of combined ranking, etc.). *UDWR comments submitted; next BC discussion pending.*

10. By June 1, the **Program Director's office** will provide a review package for Aspinall Study Plan Ad Hoc Group participants, to include: Gunnison River PBO, flow recommendations, floodplain mgmt plan, LaGory's geomorphology report, recent reports (e.g. #121 Gunnison River larval sampling), and a list of uncertainties identified in the flow recommendations, PBO, and draft EIS. *Done; ad hoc met in early June, study plan drafting is underway; next ad hoc meeting September 1-2.* The **Program Director's office** will post the summary of the June Aspinall Study Plan meeting to the fws-coloriver listserver. *Done. 11/23: Web conference held Oct. 5 & Nov. 15; draft plan pending. 12/13 review of draft/:* **Shane Capron** will provide suggested text changes. >**Committee members** should submit any additional detailed comments no later than January 14 (earlier, if possible) to Tom Chart and Angela Kantola and the rest of the Biology Committee. >The **Program Director's office** will incorporate those comments and do a thorough editorial review, then submit the revised plan to the Management Committee for their review/approval by the end of January (with

Management Committee members preferably providing specific written comments IN ADVANCE of the February 16 Management Committee). >**Tom Pitts** will send the draft document to the water users and incorporate any of their comments with those he submits by January 14.

11. **Sherm Hebein** will provide the Committee a copy of the output/report on CDOW's Gunnison River work (e.g., wherein they captured seven razorback last year in sampling half of the river) as soon as he receives it. *8/18:* ***Sherm will send to Angela*** *this week to distribute to the Committee.*

12. **Angela Kantola** will modify the final report format document and put a note in future scope of work formats specifying that authors are to provide electronic versions of draft final reports which can be commented on directly (via track changes or through Adobe, but preferably through track changes in Word [if a Word file like this is too large, the embedded Excel files can be compressed]).

13. Requirements/process for the next round of synthesis reports should be discussed by the **Nonnative Fish Subcommittee** and at the upcoming **nonnative fish workshop**. 9/30: Pat will work on the agenda for the workshop and guidance for the PI's. *Done.*

14. **Pat Martinez** will schedule a conference call among the signatories to the 2009 Nonnative Fish Stocking Procedures to discuss clarifications. *Pending. 9/30: Pat is first working to address the private sector concerns and issues regarding Rifle Gap management.*

15. **Pat Martinez and the PD's office** will work with the PI's to determine ETS electrofishing units to be ordered and where they'll be deployed. *In progress.*

16. **Angela Kantola** will modify the work plan budget table to reflect the changes to UDWR's scopes of work (#128 and #138). *#138 done; awaiting PI's approval to replace #128 SOW.*

17. **Dave Speas** will ask **Peter McKinnon** to make a presentation on his remote PIT-tag detection techniques at either DFC, the Researchers Meeting, or both.

18. The **Committee** will consider the proposal for fixed weirs at Ashley Creek and Stewart Lake drain a contingency at this time, get any comments on the scope of work to the PD's office, and have more discussion at/after the nonnative fish workshop.

19. **Tom Czapla** will send out the briefing paper he received with the humpback chub genetic data to the Biology Committee *(done)*. >At a future meeting, the **Committee** will discuss how this affects the Yampa River humpback chub captivity plan.

20. **Krissy Wilson** will send Utah's comments on the research framework to >Tom Czapla who will send these and the Service's to the Biology Committee *(done)*. >The **PD's office** will meet with the environmental groups (and perhaps other commenters) prior to the Biology Committee discussion/review of the framework so that the Committee can have a fairly focused discussion. *Done. 12/13 discussion:* The Committee decided to pursue the first

option (complete the document), and then consider the next steps at the time they review the final draft. It will be helpful for folks to see the 5-Year Reviews and see what those offer (though they may not have the level of detail folks are looking for, in the future, they certainly could reference the more detailed documents). **Committee members** should provide any additional comments on the framework to the Program Director's office (and the Committee) by January 15 (four weeks was allotted in recognition that the Biology Committee *is* the peer review for this work and Biology Committee members very much need to provide a substantive review). **Tom Czapla** will immediately provide a copy of the July version, a working link to the database referenced in the draft report, copies of the comments submitted to date, and a bold, uppercase reminder of when Committee members comments are due (January 15).

21. **Paul Badame** will revise report #138 according to comments and any additional comments >offered by **Biology Committee members** within 2 weeks and get the revisions back to the Committee by February 1. The Committee will need to look at the recommendations again before approving the report (preferably at the next meeting). **Pat Martinez** will provide suggested language regarding the shift to other species and related food-web shift to Paul. Suggestions for any changes should be *in addition* to the current protocol, so that nothing is lost.

22. To inform discussion at the February 16 Management Committee meeting, **Pat Martinez** will draft Attachment 5 into a briefing paper addressing recommendations from the recent nonnative fish workshop that differ from the 2010 status quo (see CDOW position, below) The outline/draft will be worked on by the **Nonnative Fish Subcommittee**, then come to the **Biology Committee** for review during their January 24 web conference. Tom Pitts suggested including background about current permit conditions and any agreements made regarding maintenance of the Elkhead fishery. Tom Chart agreed, and recommended including language from the Yampa River PBO, as well. Melissa suggested including language from other relevant documents, such as the Nonnative Fish Stocking Procedures, Policy, sufficient progress letter, etc., also. CDOW's Director and Steve Guertin have discussed a seeking a complete, independent review of the Recovery Program (and perhaps beyond). Tom Pitts asked what this review is about and suggested that >**CDOW** and the **Service** offer considerably greater transparency to the rest of the Program partners about the objectives and desired outcomes regarding such a review (at least by the time of the February Management Committee); others agreed. The majority of the Biology Committee recommends ceasing translocation into Elkhead Reservoir at this time, with Colorado unable to support that recommendation (thus, >**Colorado** should provide a minority report outlining the technical basis for their position). The Committee recommended that the **Nonnative Fish Subcommittee** discuss and distill workshop recommendations before they come to the Biology Committee in future years (and the subcommittee should spend more time with the recommendations beyond what the Biology Committee did today). In future years, the **Nonnative Fish Subcommittee** should discuss and distill workshop recommendations before they come to the Biology Committee.

    Assignments from review of workshop recommendations:

a. 147: **Pat Martinez** will work with FWS to determine if they should order an ETS unit. Pat will distribute design details for raft fan-style cathodes consisting of four strands of 0.25-inch diameter stainless steel cable of a length that allows 46-inches of each cable strand to be submerged in the water while trailing the raft.

b. Procedures: **Pat Martinez** will ask Anita Martinez to locate in the Procedures the requirement for state agencies to annually inspect screens and berms. Sherm Hebein will Pat a copy of one or more of their HACCP's that can be provided as an example for the private sector.

c. C18/19: **Pat Martinez** will get a draft SOW amendment from CSU for the Committee's consideration (contingent on available funding), with sorting out the difference between Green River and Flaming Gorge Reservoir the highest priority.

d. 125: The **"Team Surge" PI's** will meet soon to consider recommendations to move intensive removal into other reaches (e.g., South Beach and Craig) and revise SOWs as needed and provide those in advance of the January 24 Biology Committee web conference.)

e. 123a **UDWR** and **USFWS** will discuss moving a part of the Echo to Split 16-pass effort downstream, also considering whether people and/or reaches would be available in the Upper Yampa.

f. 161: **Pat Martinez** will work with CSU to facilitate the Nonnative Fish Subcommittee beginning to interacting with Andre (in light of what Andre showed about our level of effort from his preliminary analysis at the workshop). The Subcommittee would like to ask Andre questions about things like whether we can forego population estimates. **Pat Martinez** also will send a reminder to PI's this week regarding the deadline and format (with emphasis to those who are delinquent with 2009 data).

g. 98a: **CDOW** will address Loudy Simpson Pond berming through the Division and come back to the Biology Committee with their recommendation for berming to keep pike **currently** in the pond from escaping.

h. 110 & 123a: **Pat Martinez** will see if we have an isotope signature from Lake Powell (Derek Elverud in Utah may already have otoliths archived.)

23. **Dave Speas** will talk with Heather Patno about the best way for Utah to make their proposal for a spring flushing flow from Flaming Gorge to benefit trout. **Melissa Trammell** will find out if the Park Service can support UDWR's proposal. **Krissy Wilson** will send Matt McKell's presentation to the Biology Committee.

24. Michelle Shaughnessy's staff will spend more time with scope of work for evaluating fish condition below the Grand Valley Project fish return and get it (and a recommendation for which alternative they think would be best) back to the **Biology Committee** for discussion during the January 24 web conference.

25. Review previous meeting assignments and reports due list. The Committee did not have time to review assignments, but **Biology Committee** members will review the list and take necessary reactions. A number of reports are behind schedule and this needs to be addressed. **Committee members/PI's** will review the reports due list and provide updates or revised due dates, as required.

Attachment 2

Tusher Wash Ad Hoc Work Group
November 10, 2010
Conference call summary

Attendees: Kevin Bestgen, Tom Czapla, Kevin McAbee, Bob Norman, Tom Pitts, Dave Speas, Melissa Trammell

Kevin McAbee stated that the latest design was presented in September and included 9-inch increase on the diversion at the banks, and level across (which would result in as much as 20-inch increase in the center where it currently dips). It would include sluice gates on river right and left. It did not include any fish passage design. It is unknown what the change in volume of water diverted would be.

Specific questions regarding Kevin Bestgen's report/analyses:

McAbee: Why not use a 100% exceedence when in 2002 we may have been there?
Bestgen: It was assumed that not all the water was being diverted but potentially up to 99% could be in low flow periods.

Trammell: assumed that fish were most vulnerable to entrainment as they moved back downstream from spawning areas to downstream reaches, which occurs during low flow periods of the year. Bestgen: this scenario assumed that fish had one opportunity for entrainment per year, likely when young adults were moving upstream from lower river nursery areas. If fish move back downstream then mortality rates could double, because there would be two entrainment encounters. But most fish from the lower river are young adults making their way upstream as they do as part of their life history. Trammell: so, only a portion would be vulnerable to two entrainment encounters as they return downstream.

The turbines represent the majority of the mortality in the scenarios depicted, not the irrigation canals. Mortality is additive: turbines plus canals. With screening or retrofitting the turbines, the biggest reduction in mortality would occur in the low flow time frames, because those have the greatest entrainment percentage. The overall mortality is 20%, and 1-7% is a result of the diversion, over a couple hundred fish at 6-7% during low flow. The 50% mortality at the turbines is highly uncertain, that's just the number that was used.

Thane hydropower uses old generators (Kaplan) that are taken from other places no longer using or upgrading their own systems. Kaplan turbine might have a 70% mortality on fish; newer "fish-friendly" turbines could get up to 6-10% mortality (90-94% survival), but both of these rates are estimates with uncertainty.

Would raising the diversion structure require modifying the turbines? Raising the diversion would increase the head for running the pumps, and have a more stabilizing effect on the flow than operating under the variability currently occurring (they have a water right for 800 cfs).

Can't get to a decision until we know what they plan on developing. Recommendations made by this ad hoc work group will be made with regard for how the system is currently operating.

If the diversion is going to be raised then the Fish and Wildlife Service will have to approve the fish passage and the operators need to know that they will be responsible for any operation and maintenance of the passage.

Mortality through low-head turbines is generally caused by impacts of the fish with the impeller. Is a mortality study needed? Mortality study would be useful to understand cost and benefit ratios since differences in turbine mortality may equate to only marginal changes in percentage of total pikeminnow mortality (figure 4 in Bestgen white paper). However, even small changes in pikeminnow mortality could be biologically significant and significant to ESA as they relate to recovery criteria of mortality being less than recruitment.

Norman mentioned the barrier wall at hogback (San Juan River) was a third the price of what a screen would have been.

1. Full screen, weir or barrier wall on raceway
2. Just screen the irrigation canals (barrier wall, rotating drum, other)
3. Screen irrigation canals and replace turbines
4. Retrofit to fish friendly turbines

Need to evaluate the benefits of each option (i.e. decreasing mortality), during high, median and low flow years, along with associated costs (ball park if necessary).
Bestgen's report provides some good estimates based on the assumptions; what would the numbers look like if a new turbine provided 90% survival?

Chart's original list of options:

1. Screen Entire Canal (using the Grand Valley model. using a weir; or a barrier wall)
2. Replace hydroplant with fish friendly turbines and screen irrigation diversion w/ fish returned directly to river
3. Replace hydroplant with fish friendly turbines and screen irrigation diversion w/ fish shunted thru powerplant
4. No change at powerplant - screen irrigation diversion w/fish returned directly to the river
5. No change at powerplant - screen irrigation diversion w/ fish shunted thru the existing power plant.

November 24, 2010
Conference call summary

Attendees: Kevin Bestgen, Tom Czapla, Kevin McAbee, Bob Norman, Tom Pitts, Dave Speas, Melissa Trammell, Bob Norman.

Two causes of mortality, strike and pressure changes. Assuming the only mortality on larval fish is screening the canal. If strictly concerned with screening option, all five options would have same mortality for larvae. The hydroplant will have differential mortality. The question is not about the larval size, but rather the early life stages of juvenile. Movements of YOY of fish and larger, are they going to be moving past Tusher wash.

Need to focus on larger juvenile and adult fish. Larval mortality only considered on the full screen option at low flows, because the rest of it is considered neutral on the other options. During low flow periods, most of the river would be going through the screen larvae would have a higher rate. But not all larvae would necessarily be impinged or killed. Screens are designed to sweep away small things so some would survive.

The analysis we have been considering the large juvenile and adult fish. Earlier the Program screened for adults because that seemed reasonable and manageable. One inch openings was initially recommended, but was not good for trash [needed to go smaller (3/32nds) or larger (6")]. Melissa thought there was more larval mortality associated with the full screen than the other options, based on previous discussions. Bestgen said he did not know, but there should be a positive benefit for early life stages from the full screen option.

We need to consider the larger juveniles and adults and work on completing the table.

Why not consider just the low flow scenarios that would have the most impacts. Should we look at the very low flow (99% exceedence=drought conditions), recognizing that the occurrence is very infrequent.

Option 2 (Replace turbines with fish-friendly turbines and screen irrigation diversion with fish returned directly to river) and option 4 (No change at turbines - screen irrigation diversion with fish returned directly to the river), does not seem possible. It would take a substantial amount of rehabilitation to return the fish to the river and the mortality numbers have not been generated. Engineering solution would be extremely complex.

Option 3 - Fish are screened out of irrigation and then they go through the fish friendly runners

200 cfs goes through the runner and 35 cfs goes through the irrigation pump.

For option 0 (no action), assumes 50 % mortality through runners and no screening of the canal. One recommendation would be to consider a study to determine the "real" mortality through the current operating runners.

Option 5 should probably fall between option 3 and the 80% survival in the river.

What we need for recovery? Overall survival rate increases under increasing population sizes. Consider the early 2000's when a declining population had a lower survival rate under drought conditions.

December 2, 2010
Conference call summary

Attendees: Kevin Bestgen, Tom Czapla, Tom Chart, Kevin McAbee, Bob Norman, Tom Pitts, Dave Speas, Melissa Trammell.

The subcommittee thanked Kevin Bestgen for his work on this analysis. The subcommittee reviewed Kevin Bestgen's phase III analysis (appendix 1) of Tusher mortality and screening options. Kevin provided a table of expected changes in adult/subadult Colorado pikeminnow survival based on 3 screening options, relative to a baseline level of 80% adult survival of the riverwide population of Colorado pikeminnow. Cost estimates were added by Bob Norman. The current estimated baseline survival of 80% includes effects of Tusher diversion. This table represents what survival might be if the effects of Tusher were mitigated by the various screening options, given the assumption of 50% turbine mortality.

	2006-2008				2000–2003				
	65% flow exceedence				85% flow exceedence				
Options	Moderate survival (80%), moderate recruitment				Low survival (65%), low recruitment				Cost (ballpark estimates only)
	high flow (15% exceedence, 5.4% div rate)	mod flow (50%, 16.6% div rate)	low flow (85%, 32.5% div rate)	drought (99%, 65.9% div rate	high flow (15% exceedence, 5.4% div rate)	mod flow (50%, 16.6% div rate)	low flow (85%, 32.5% div rate)	drought (99%, 65.9% div rate	
1. Screen entire canal (using the Grand Valley model, weir; or a barrier wall)	80.41	81.38	82.68	85.36	65.51	66.73	68.35	71.7	$7.1 M; barrier wall not feasible
2. Replace turbines with fish-friendly turbines and screen irrigation diversion with fish returned directly to the river.	NA								
3. Replace turbines with fish-friendly turbines and screen irrigation diversion with fish shunted thru turbines	80.34	81.02	81.98	84.43	65.42	66.28	67.48	70.53	$2.2 M
4. No change at turbines – screen irrigation diversion with fish returned directly to the river	NA								
5. No change at turbines - screen irrigation diversion with fish shunted thru the existing turbines	80.05	80.18	80.35	80.7	65.07	65.23	65.44	65.87	$2.2 M

Speas: In Figure 6 why is there an asymmetrical decline? There is likely something else driving that trend. Lower panel represents a reasonable scenario of moderate flow conditions. Option 6 is the do nothing (no action); population would be increasing based on survival and recruitment rates under moderate conditions, but likely declining under low flow conditions as it did in early

2000s. The increase in survival in low flow periods may be more important than in moderate flow periods.

In response to Tom Pitts' earlier question of considering some other action we could take that might have similar or improved positive impact; the SC can't think of anything else to do to that would increase the population by 4%. But for $7M is it worth it. The Kitcheyan et al (2001) and Cavalli (2000) studies demonstrated that entrainment occurs. Fish of several species were captured in the canal leading to the power plant (raceway) and in the first mile of the irrigation ditch itself, including 5 adult Colorado pikeminnow and one razorback sucker in the irrigation ditch. 2000 was a moderate flow year, and would not expect a great deal of entrainment. Some of those fish may have been returned to the river through the first sluice, about a mile down the irrigation canal. Agree there are a lot of fish at risk.

Pitts asked does 66% entrainment rate involve the entire population? The 6.5% is the percentage of the entire population; 66% entrainment rate (66% of the river is going through the canal) is rarely seen (99% exceedence level). It is the entire population.

Court case on flows was completed in 2006/2007, which has the legal right of how much water can be taken. The real exposure to the fish is what happens, not the legal requirement. Screen to their legal requirement not just a couple hundred cfs. Probably run 705 cfs through hydro after the irrigation season. Thayne have the right for 600 cfs with irrigation at 35; and the 60 cfs for a total of 695. Tom Pitts will check into the legal right.

Bob Norman: Barrier wall is not feasible. The barrier wall proposed for the hogback diversion (San Juan River) has conducive things such as no hydro, allowing placement of gates to divert water back to the river from irrigation, but here it is going into hydro. Water on the upstream barrier wall, having river fluctuations of a couple feet the barrier wall would allow more water at high flows that would entrain the fish. Screen just the 100 cfs, would be about $1M. Replacing the runners, all 3, that would be about $2M, for a total of $3M for option 3.

There is the issue of operating and maintaining the screens; particularly the full screen option would require as much upkeep and maintenance as the grand valley screens which can be considerable time and effort.
Would we want to quantify the mortality through the current turbines? We could be spending a couple million dollars and not achieving much gain in survival. The existing runners may be too small to install true 'fish friendly' runners. The manufacturing Company said with small runners to adapt to being fish friendly. Norman thinks we need that mortality information. If we currently have 50% survival through the turbines and we gain 90% that's great; if we have 70% currently and get 80%, that's not much.

Chart wondered is there something to be gained by just looking at what currently there, which may be real easy. It comes down to how many fish the turbines are killing. There may be things that could be done to the Kaplan's to reduce mortalities, not necessarily "fish-friendly runners". Bob Norman does not believe it would be possible to tell what mortality would be just by looking.

Recommendations:

- Review the literature for appropriate study design and answering the right questions.
- Do the mortality study through runners and determine what improvements could reduce fish mortality (visual inspection of the runners).
- Screen the 100 cfs for irrigation (option 3).

The subcommittee then adjourned, but some member stayed on to discuss technical aspects of the analysis. With apologies to the rest of the subcommittee, additional information was discussed briefly that may make options 2 and 4 more practical – that is, if the 60 cfs irrigation can be screened separately, and the 35 irrigation that is pumped uphill is not screened, then the screened fish may be returned to the river via existing sluices or other means. An estimate of cost was not made but could be much less expensive than the est.1 million to screen both irrigation diversions.

Appendix 1:

Potential entrainment mortality of Colorado pikeminnow into Tusher Diversion, lower Green River near Green River, Utah

Kevin R. Bestgen
Larval Fish Laboratory
Department of Fish, Wildlife, and Conservation Biology
Colorado State University
Fort Collins, Colorado 80526

December 2010

Various risk model scenarios were estimated to better understand potential entrainment and mortality of Colorado pikeminnow *Ptychocheilus lucius* in Tusher Diversion, lower Green River, Utah. This represents **version III** of this report. The second version was updated with better flow and operational criteria for the diversion, courtesy of Mr. Robert Norman, U. S. Bureau of Reclamation, Grand Junction, Colorado. This third version includes additional scenarios to better understand the impact of various options for Tusher Diversion, including a no change option, and begins on page 9.

Diversion operation is complicated (Figure 1). Green River flow is pooled by the upstream diversion dam and funneled into the raceway. It was assumed that the entirety of the river could be diverted, or nearly so. Once in the raceway, water goes to one of four locations. As indicated, 200 cfs goes to each of two Hydro units (location 1). Another 200 cfs goes to the Hydro pump (location 2), and it and the Hydro Units are collectively called turbines. The Hydro pump delivers water to supply the 42' canal with about 35 cfs during the irrigation season (location 3). The remaining water goes to the Green River Canal through a headgate, an average amount estimated to be about 70 cfs (location 4). Thus, total flow into the canal and through or into the four locations was assumed to be 705 cfs. In the non-irrigation season, 600 cfs is used for power production (B. Norman, pers. comm.).

Potential entrainment rates assumed for all fish at risk for all scenarios ranged from 1-66%. Entrainment rates were based on two factors: flow volume of the river and flow volume entrained, the latter of which was constant at 705 cfs. Flow of the river during the irrigation season (1 April to 31 October) was estimated from the U. S. Geological Survey gauge at Green River, Utah (09315000) for the post-Flaming Gorge Dam period, 1964-2009, and a flow duration curve was developed (Figure 2). The lowest proportion of river water entrained into the diversion raceway (1%) would be during the highest river flows and corresponded to an exceedence value of 1%, the amount of time the flow exceeded 29,500 cfs in the period of record for the season described. The highest entrainment rate, 66%, occurred when flow of the Green River was only 1070 cfs, which corresponded to an exceedence value of 99%. The 50% exceedence value for the Green River for the period of record considered was 4250 cfs, a flow level which corresponded to 16.6% river diversion rate (705/4250 = 16.6%).

The irrigation season designation was used because that was when flow was being diverted to the irrigation canals; most flow, that for use for the power plant, was for the entire year. The irrigation season likely represented the peak timing of movement associated with spring-summer reproduction of Colorado pikeminnow *Ptychocheilus lucius* in the Green River (Tyus 1990); other seasonal movement data are largely lacking. An assumption made was that a pikeminnow in the population at risk had a single chance per year to be exposed to and entrained in the diversion. It was also assumed that pikeminnow were entrained in proportion to the amount of flow entrained (e.g., uniformly distributed in the river). Colorado pikeminnow may be concentrated on river banks and so this method may underestimate the number at risk even if fish on both banks are considered. It was also assumed that pikeminnow would be entrained at one of the four locations in proportion to the amount of flow in each.

The number of fish at risk was based on Colorado pikeminnow abundance estimates for the Green River subbasin for 2008, the most recent ones available (Bestgen et al. 2008, Bestgen et al. 2010). All fish in the lower Green River reach, adult or otherwise, were considered at risk because they transition at high rates upstream and would be susceptible to entrainment (we do not know the seasonal aspects of this well, importantly, when they are moving relative to when water is diverted); some fish also transition downstream. The Deso-Gray Canyon reach abundance estimates were scaled by the proportion of habitat in the reach (198 RK total) that was downstream of Tusher Diversion (7.0%), and by an equal amount upstream (7.0%) to account for potential entrainment of pikeminnow in close proximity to the diversion. In other words, 14% of the Deso-Gray population was considered at risk. The number of adult fish at risk in both reaches was 648 out of 3,672 total adult pikeminnow basin wide (17.6%); the number of juvenile, recruit, and adult fish at risk was 1,020 out of a total basin wide estimate of 4,799 (21.2%). Based on similar methods, 14.6% of the pikeminnow population in the Green River Basin was at risk for 2003 when estimates were available for the period 2000-2003 (Bestgen et al. 2007).

Under entrainment rates ranging from 1-66% for at-risk fish, the number of fish entrained (adult or juveniles, recruits, and adults) was estimated. That number was reduced by 20% (80% survival of adult and other fish in the Green River Basin, Bestgen et al. 2010) to account for the number of fish that would have otherwise died annually. I assumed diverted flows and fish went into the irrigation canals at a 15% rate (105/705 cfs = 15%) with an associated 100% mortality rate. The 100% mortality rate was used because fish had no chance of survival once in the canals. The remainder of the flows and fish, 85%, went to the Hydro or Pump Units (turbines), where mortality rates of 10, 30, 50, and 80% were simulated. All mortality rates were portrayed as a percentage of the total Green River Basin population of Colorado pikeminnow.

The first scenario compared adult fish % mortality to juvenile, recruit, and adult fish % mortality (Figure 3), and assumed a 100% mortality rate in the canals and a 50% mortality rate for fish passed through the turbines. Maximum mortality rates of adult fish at risk relative to the entire Green River population was 5.4% (n = 198) at the highest 66% entrainment rate, and 0.1% (n = 4) at a 1% entrainment rate; the mortality rate at the 50% exceedence flow (16.6% entrainment rate) was 1.4% (n = 51). Maximum mortality rate of juvenile, recruit, and adult fish collectively at risk relative to the entire Green River population was 6.5% (n = 312)at the highest 66% entrainment rate, and 0.1% (n = 5) at a 1% entrainment rate; the mortality rate at the 50% exceedence flow was 1.7% (n = 82) and was higher than the adult-only rate, because the younger life stages made up a larger portion of the population at risk in that area compared to that in the basin as a whole.

In a second scenario, and with the 15 and 85% diversion rates to the irrigation canals and turbines, respectively, I also compared potential turbine mortality rates for adult fish of 10, 30, 50, and 80% to assess overall mortality and the potential change in mortality achieved by a turbine retrofit (e.g., reduction of mortality from 30 to 10%; Figure 4). Little is known about fish mortality in these types of turbines so a wide range of mortality values was chosen. At the highest entrainment rate of 66%, mortality rates for at risk adult fish relative to the total number of fish in the Green River Basin were 2.2, 3.8, 5.4, and 7.7% assuming 10, 30, 50, and 80% turbine mortality rates, respectively. At the lowest 1% entrainment rate, mortality rates for at risk adult fish relative to the total number of fish in the Green River Basin were 0.1% or less, assuming 10, 30, 50, and 80% turbine mortality rates, respectively. At the median entrainment rate of 16.6% (diversion flow entrainment of 705 cfs at the 50% Green River flow exceedence value of 4250 cfs), mortality rates for at-risk adult fish relative to the total number of fish in the Green River Basin were 0.6 (n = 22 fish), 1.0 (n = 37), 1.4 (n = 51), and 2.9% (n = 106) assuming 10, 30, 50, and 80% turbine mortality rates, respectively.

In the third scenario, mortality rates and number of fish mortalities for adult pikeminnow were compared for the irrigation canal and the turbine units, where mortality was assumed 100 and 50%, respectively (Figure 5, panels a and b). Mortality rates were much higher for the turbine units because of the larger amount of flow that passed through them compared to the irrigation canals, this in spite of the higher irrigation canal mortality rates. All basic data are in Table 1.

Substantial uncertainties exist and include:

Is fish distribution in the river uniform and what are expectations for entrainment given some proximity to the mouth of the diversion,

Is fish entrainment 100% once in the raceway canal (can/do fish leave),

Is fish entrainment proportional to flow at various locations in the raceway (or do fish preferentially go into irrigation canals at higher or lower rates),

Is the irrigation season and a one-time chance for entrainment realistic,

Are the turbine mortality rates realistic and can they be improved,

Many others.

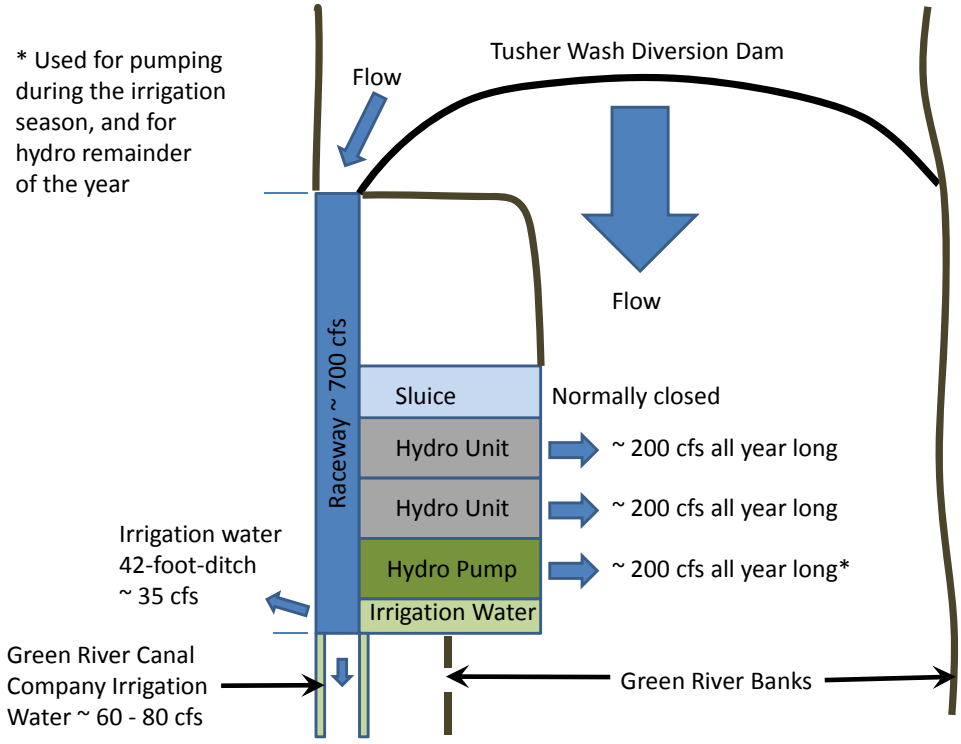


Figure 1. Schematic of Tusher diversion works, lower Green River near Green River, Utah, courtesy of B. Norman, USBR, Grand Junction, Colorado.

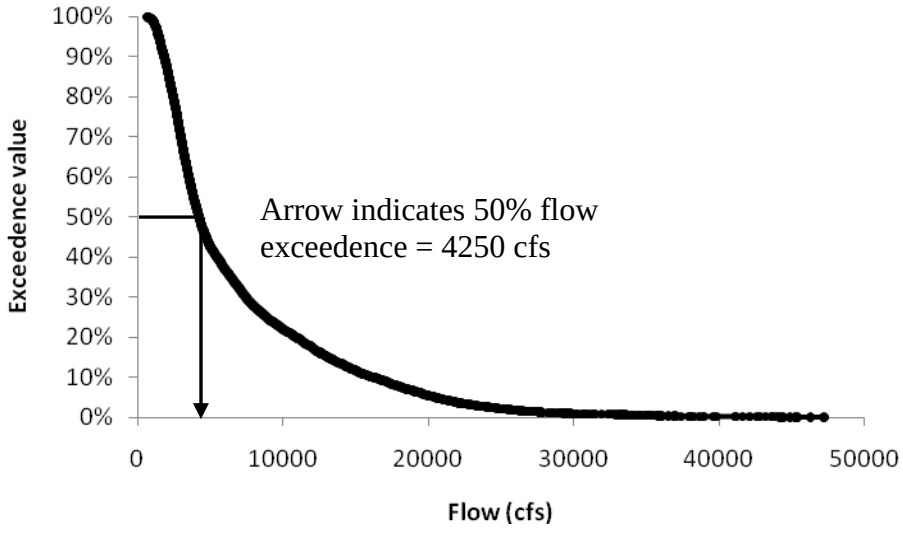


Figure 2. Flow-duration curve (% exceedence) for the lower Green River, at Green River, Utah, for irrigation season flows (1 April to 31 October), 1964 to 2009.

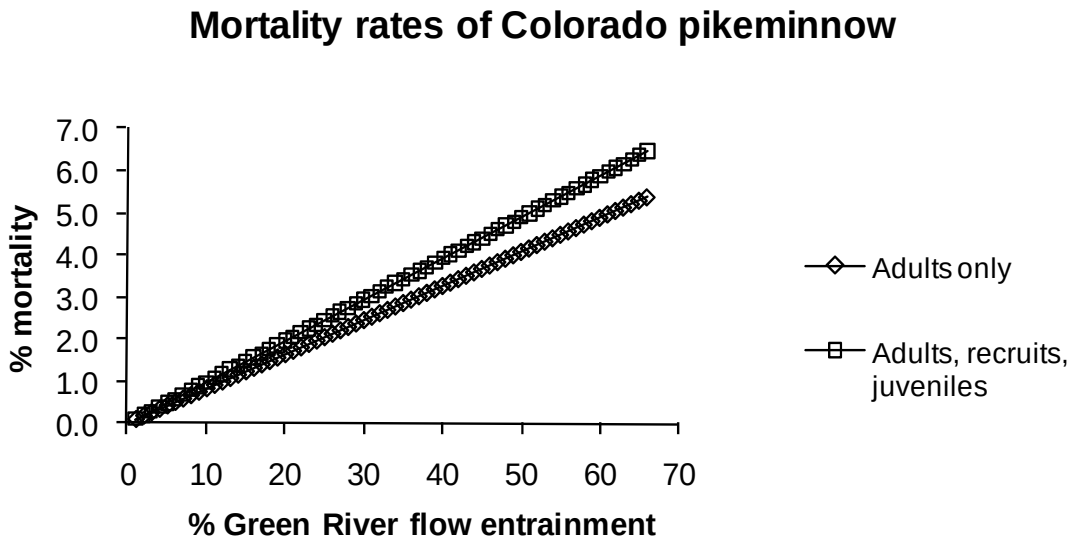


Figure 3. Hypothetical mortality rates of adult only and juvenile (300-399 mm total length [TL]), recruits (400-449 mm TL), and adult (> 449 mm TL) Colorado pikeminnow as a function of entrainment rates of Green River flows into Tusher Diversion, lower Green River, near Green River, Utah. Scenarios assume mortality rates of 50% for diverted Colorado pikeminnow passing through powerplant turbines and the powerplant pump, and 100% mortality for those fish passed into either of two irrigation canals. Percent mortality rates are based on the proportion of mortalities relative to the total population present in the Green River subbasin in 2008 (Bestgen et al. 2010).

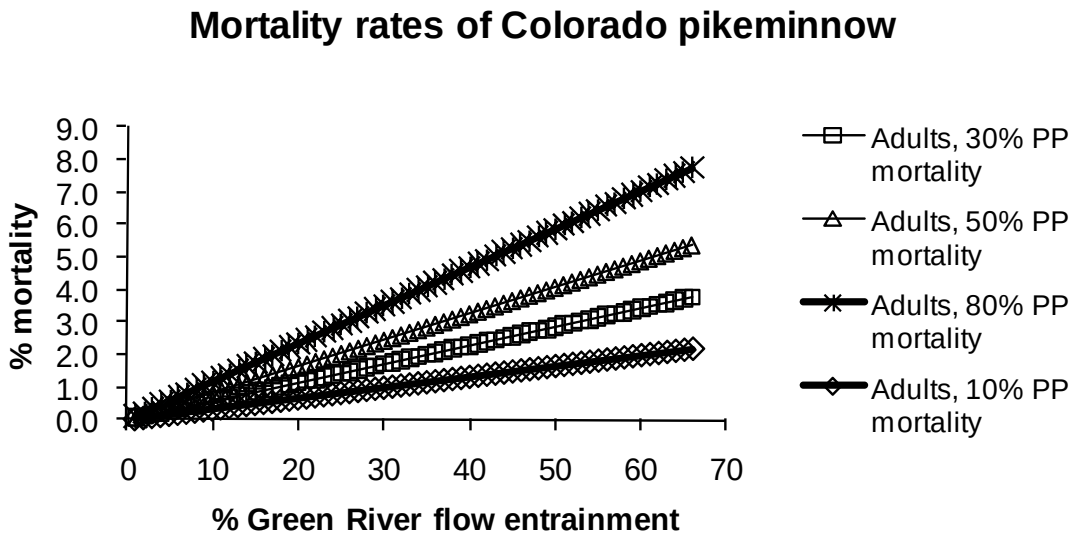
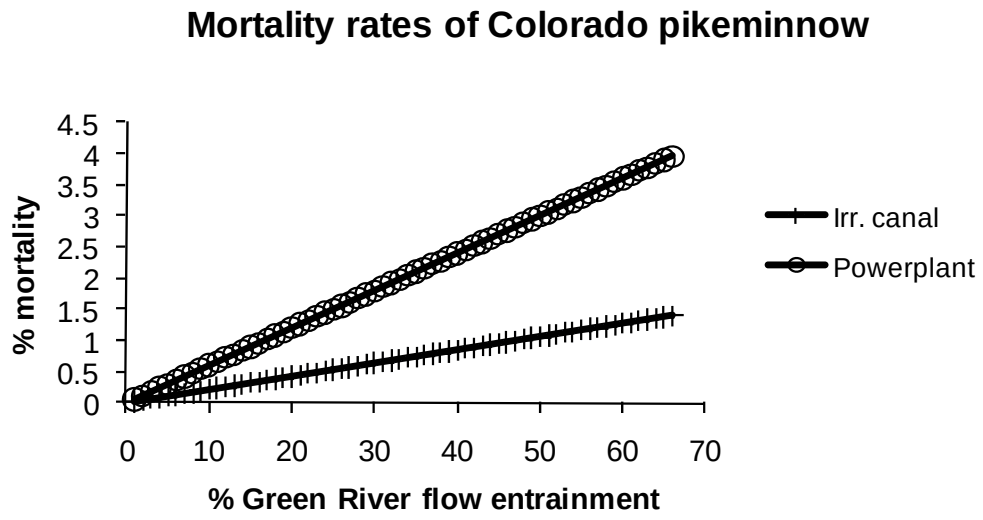
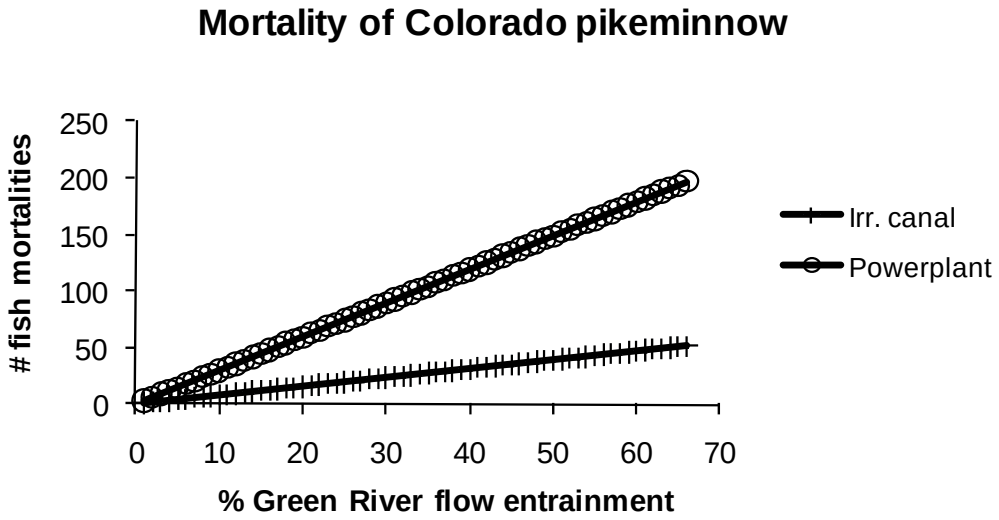


Figure 4. Hypothetical mortality rates of adult (> 449 mm TL) Colorado pikeminnow as a function of entrainment rates of Green River flows into Tusher Diversion, lower Green River, near Green River, Utah. Scenarios assume mortality rates of 10, 30, 50, and 80% for diverted Colorado pikeminnow passing through powerplant turbines and the powerplant pump, and 100% mortality for those fish passed into either of two irrigation canals. Percent mortality rates are based on the proportion of mortalities relative to the total population present in the Green River subbasin in 2008 (Bestgen et al. 2010).



Panel A



Panel B

Figure 5. Hypothetical mortality rates (panel A) and number of adult (> 449 mm TL) Colorado pikeminnow mortalities (panel B) as a function of entrainment rates of Green River flows into Tusher Diversion, lower Green River, near Green River, Utah, for both the powerplant turbines and two irrigation canals. Scenarios assume mortality rates of 50% for diverted Colorado pikeminnow passing through powerplant turbines (and the powerplant pump), and 100% mortality for those fish passed into either of the two irrigation canals. Percent mortality rates are based on the proportion of mortalities relative to the total population present in the Green River subbasin in 2008 (Bestgen et al. 2010).

Table 1. Basic mortality rate data for various scenarios displayed in figures 1-3.

				Total mortality				Irr. Canal	Powerplant
		%mortality	%mortality	% mortality	% mortality	%mortality		# fish	# fish
River	Life stage	Adults	Adults	Adults	All stages	Adults			
Entrainme	Flow %	15-85	15-85	15-85	15-85	15-85		15-85	15-85
rate	Mort. Rate	10-100	30-100	50-100	50-100	80-100		100%	50%
66		2.2	3.8	5.4	6.5	7.7		51	197
65		2.2	3.7	5.3	6.4	7.6		51	194
64		2.1	3.7	5.2	6.3	7.5		50	191
63		2.1	3.6	5.1	6.2	7.4		49	188
62		2.1	3.5	5.0	6.1	7.3		48	185
61		2.0	3.5	5.0	6.0	7.1		47	182
60		2.0	3.4	4.9	5.9	7.0		47	179
59		2.0	3.4	4.8	5.8	6.9		46	176
58		1.9	3.3	4.7	5.7	6.8		45	173
57		1.9	3.3	4.6	5.6	6.7		44	170
56		1.9	3.2	4.5	5.5	6.6		44	167
55		1.8	3.1	4.5	5.4	6.4		43	164
54		1.8	3.1	4.4	5.3	6.3		42	161
53		1.8	3.0	4.3	5.2	6.2		41	158
52		1.7	3.0	4.2	5.1	6.1		40	155
51		1.7	2.9	4.1	5.0	6.0		40	152
50		1.7	2.9	4.1	4.9	5.9		39	149
49		1.6	2.8	4.0	4.8	5.7		38	146
48		1.6	2.7	3.9	4.7	5.6		37	143
47		1.6	2.7	3.8	4.6	5.5		37	140
46		1.5	2.6	3.7	4.5	5.4		36	137
45		1.5	2.6	3.7	4.4	5.3		35	134
44		1.5	2.5	3.6	4.3	5.2		34	131
43		1.4	2.5	3.5	4.2	5.0		33	128
42		1.4	2.4	3.4	4.1	4.9		33	125
41		1.4	2.3	3.3	4.0	4.8		32	122
40		1.3	2.3	3.2	3.9	4.7		31	119
39		1.3	2.2	3.2	3.8	4.6		30	116
38		1.3	2.2	3.1	3.7	4.5		30	113
37		1.2	2.1	3.0	3.6	4.3		29	110
36		1.2	2.1	2.9	3.5	4.2		28	107
35		1.2	2.0	2.8	3.4	4.1		27	104
34		1.1	1.9	2.8	3.3	4.0		26	101
33		1.1	1.9	2.7	3.2	3.9		26	98
32		1.1	1.8	2.6	3.1	3.7		25	95
31		1.0	1.8	2.5	3.0	3.6		24	92
30		1.0	1.7	2.4	2.9	3.5		23	89
29		1.0	1.7	2.4	2.8	3.4		23	86
28		0.9	1.6	2.3	2.7	3.3		22	83
27		0.9	1.5	2.2	2.6	3.2		21	80
26		0.9	1.5	2.1	2.5	3.0		20	78
25		0.8	1.4	2.0	2.4	2.9		19	75
24		0.8	1.4	1.9	2.3	2.8		19	72
23		0.8	1.3	1.9	2.2	2.7		18	69
22		0.7	1.3	1.8	2.2	2.6		17	66
21		0.7	1.2	1.7	2.1	2.5		16	63
20		0.7	1.1	1.6	2.0	2.3		16	60
19		0.6	1.1	1.5	1.9	2.2		15	57
18		0.6	1.0	1.5	1.8	2.1		14	54
17		0.6	1.0	1.4	1.7	2.0		13	51
16		0.5	0.9	1.3	1.6	1.9		12	48
15		0.5	0.9	1.2	1.5	1.8		12	45
14		0.5	0.8	1.1	1.4	1.6		11	42
13		0.4	0.7	1.1	1.3	1.5		10	39
12		0.4	0.7	1.0	1.2	1.4		9	36
11		0.4	0.6	0.9	1.1	1.3		9	33
10		0.3	0.6	0.8	1.0	1.2		8	30
9		0.3	0.5	0.7	0.9	1.1		7	27
8		0.3	0.5	0.6	0.8	0.9		6	24
7		0.2	0.4	0.6	0.7	0.8		5	21
6		0.2	0.3	0.5	0.6	0.7		5	18
5		0.2	0.3	0.4	0.5	0.6		4	15
4		0.1	0.2	0.3	0.4	0.5		3	12
3		0.1	0.2	0.2	0.3	0.4		2	9
2		0.1	0.1	0.2	0.2	0.2		2	6

Part III.

This phase of the report further develops the potential survival rate increases realized under various modification options for Tusher Wash Diversion (Table 2). In general, the percentage of fish saved increases at lower flow levels (higher diversion rates) because the percentage of the river and fish in the river diverted into Tusher Diversion and associated turbines increases. Screening the entire canal (Option 1) offered the highest level of fish protection, with increases of 0.4, 1.4, 2.7, and 5.4% for the high, moderate, low, and drought flow level scenarios, respectively. Replacing turbines or runners that cause lower mortality (change from 50% to 10% mortality) and screening diversions to canals and shunting those fish through turbines was also relatively effective. Simply screening canals (Option 3) and shunting fish through turbines, which resulted in a hypothetical 50% mortality rate, resulted in only a marginal increase in overall fish survival over the baseline (do nothing) condition because the amount of water diverted to canals was small relative to the turbines, and 50% of fish saved by screening ultimately suffered turbine mortality.

Another method of assessing the utility of various modifications (1, 3, and 5) at Tusher Diversion is to use abundance estimates combined with estimated survival and recruitment rates to understand how much population dynamics of pikeminnow would be affected compared to a baseline rate (Option 6). Two sets of basinwide Green River estimates are available, one starting in 2001 (n = 3304 adults, fish > 449 mm TL) and one starting in 2006 (n = 2454 adults). The first set of estimates were gathered when population size was relatively high but declining, survival rates of adults (0.65) and recruit-sized fish (400-449 mm TL, 0.54) was low, recruitment was low (average in 2001-2003 = 275 recruits per year), and flows (85% exceedence value for the 2000-2003 period) were low (Bestgen et al. 2007). Average numbers of recruits per period, not estimated abundance, were used to reduce the variability and to isolate changes to only those attributable to Tusher Diversion modifications; all recruits were assumed to come from the reach affected by Tusher Diversion, an assumption mostly supported by empirical data because the lower Green River is the major recruitment area for the basin (Bestgen et al. 2007; 2010). The proportion of the population affected in the early period was 14.6%, slightly lower than that for the later period (17.6%) as detailed earlier. Thus, only the proportion of the population affected by Tusher Diversion was subjected to the mortality rates that were affected by Tusher Diversion; the remainder of the population was subjected to the background mortality rate (0.65 in the early period, 0.80 in the later period). The second occurred when population size was relatively low but increasing, survival rates of adults (0.80) and recruit-sized fish (400-449 mm TL, 0.80) was moderate, recruitment was moderate (n = 635 recruits per year), and flows (65% exceedence value for the 2000-2003 period) were low but higher than in the previous period (Bestgen et al. 2010).

Starting baseline population sizes of adults and recruits were subjected to appropriate mortality rates, and recruits were added to adult populations. Trends were extended one year past the estimation period (2004 for early period and 2009 for later period) because population sizes and trends were relatively well understood. Mortality rates were then altered by increasing survival rates for the proportion of the population at risk for the various options 1, 3, and 5 to see the effects of Tusher Diversion modifications relative to the baseline.

As expected, Options 1 and 3 had the largest effects on pikeminnow population trends (Figure 6a). In the period of low survival, population size declined by 62 and 62.3% for those options,

respectively, compared to 63 and 63.2% for options 5 and 6, respectively. In other words, over the scope the estimation period, survival was increased by option 1 by about 1.2% over the baseline option. The declining trend was caused mostly by lowered survival and very low recruitment during 2000-2003 (Bestgen et al. 2007); the hypothetical trend was slightly more pronounced than that observed. Regardless, screening the entire Tusher Diversion intake only slightly slowed the rate of decline.

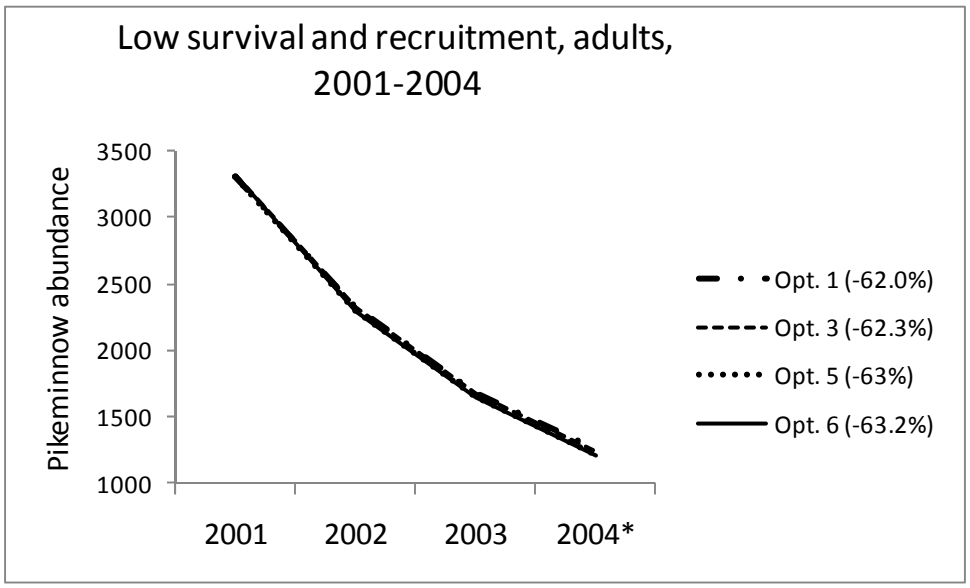
In the moderate survival scenario, effects of various Tusher Diversion modifications were similarly ranked relative to the low survival scenario discussed above and more positive because populations were increasing. Over the 4 year hypothetical study period, populations increased 1.7% (Option 6) by doing nothing because recruitment and survival was higher than in the earlier period and collectively, were higher than the mortality rate. Option 5 (2.1%) was only slightly better than Option 6. Options 1 and 3 were substantial improvements over Option 6 (4.6 and 3.9% population increase due to modifications). Projected increases in population size under Option 1 increased population size to > 2,600 by 2010, while simulated population size for Option 3 increased population size to > 2,600 by 2012; population size for options 5 and 6 did not exceed 2,600, the minimum recovery population size in the Green River until 2015 and 2017, respectively. Again, these simulated population growth rates do not reflect estimated numbers based on tag-recapture studies because large numbers of juveniles (in 2006) and recruits (in 2007) increased the population size faster in 2008 (Bestgen et al. 2010). The important thing to remember is that duration of time to recover pikeminnow populations to the level of 2,600 was affected only by differences in the options for Tusher Diversion.

One last method to realize the potential impacts of a Tusher Diversion modification on pikeminnow populations is to assume some portion of the population is subjected to repeated encounters with Tusher Diversion. This may be a reasonable scenario because some portion of the lower Green River and lower Desolation-Gray Canyon of pikeminnow may be resident and some of those fish likely pass the diversion during annual spawning migrations, and implicitly may do so more than once per year. Also, transitions from upstream reaches to the lower Green River, while low (0.02, Bestgen et al. 2007; 2010), also occur. The single annual encounter assumption used throughout this report may be conservative and would increase the potential mortality rates and reduce the efficacy of various screening options to increase survival of pikeminnow.

The scenarios again use survival rates for each of the low (2000-2003) and moderate (2006-2008) survival periods. These scenarios were estimated for each of options 1, 3 and 5, and data are portrayed as the % increase *over* the level expected based on the baseline condition of survival, 0.65 in the early period and 0.80 in the later period for a 10-year period. Thus, the baseline condition is not portrayed in the figures but would be a flat line across the bottom of the graph showing no increase over time. Another way to understand this scenario is to envision a population declining at a rate due to the mortality present for a given scenario. The number of fish "saved" over the baseline rate is the % increase at a specific time. For example, if a 1000 fish in a population at risk die over a 10-year period at rates of 0.80 per year (baseline) and 0.8536 per year (drought condition, moderate survival scenario), 107 and 205 fish would remain, respectively. Thus, the 205 represent a 91.2% increase over the baseline number (205-107 = 98; 98/107*100 = 91.2%) of 107.

Again, in each of the low and moderate survival rate periods, the % increases in population size over the baseline condition was highest for options 1 and 3, followed by relatively small increase for Option 5 (Figure 7). Also as previously discussed, the % increases are higher at lower flow scenarios because a larger proportion of the population is at risk during that time. The relatively smaller % increase in population size for the moderate survival scenario relative to the low survival scenario was because the same relative % increase was used for each scenario (5.36%), which would result in a larger % increase for the lower than the moderate survival rate. For example, under the drought scenario in Option 1 the percentage increase over baseline (5.36%, or 85.36% total survival) represents 6.7% (5.36/80 = 6.7) of 80%. In comparison, under the same scenario for the low survival period, the survival rate for Option 1 would be 71.7% (e.g., drought scenario in Option 1, 65% + 6.7% = 71.7%, this needs checking). In this manner, the relative % increase is kept constant over different baseline survival rates (see Table 2 caption). Only scenarios for the moderate, low, and drought flows were estimated as entrainment and subsequent mortality during high flow scenarios is low.

Table 2. Survival rates of Colorado pikeminnow estimated to increase over baseline rates of 80 and 65% under different modifications of Tusher Diversion and different flow rates. Moderate survival rates, with associated moderate recruitment rates, were estimated from capture-recapture studies from 2006-2008. Low survival rates, with associated low recruitment rates, were estimated from capture-recapture studies from 2000-2003. High flows in the period 1 April-31 October, the irrigation period, were 15% of Green River exceedence values for the period 1964-2009, and estimated 5.4% of the river would be diverted. Moderate flow, low flow, and drought flow exceedence values and diversion percentages are in the table. Mean flows in the 2006-2008 period represent 65% exceedence levels, and mean flows in the 2000-2003 period represent 85% exceedence levels for the period 1964-2009. Tusher Option 1 was to screen the entire canal, with the assumption that there was no associated mortality from the screen. Option 3 replaces turbines with reduced mortality runners, from an assumed 50% mortality to 10% mortality for fish passing through them. Option 5 assumes 50% mortality for fish passing through turbines, so 50% of fish saved from diversion canals (otherwise 100% mortality) in this option would incur mortality. Options 2 and 4 were deemed not tractable at this time but were retained in the table for the record. The low survival scenario increases in survival were based on those for the moderate survival scenario. This was done by calculating the % increase over baseline for a scenario and calculating that as a percentage of the baseline. For example, under the drought scenario in Option 1 the percentage increase over baseline (5.36%) represents 6.7% (5.36/80 = 6.7) of 80%. That value and others similarly calculated were then added to the low survival scenario baseline values (e.g., drought scenario in Option 1, 65% + 6.7% = 71.7%, need to check this, not sure this is not overestimated). In this manner, the relative % increase is kept constant over different baseline survival rates.



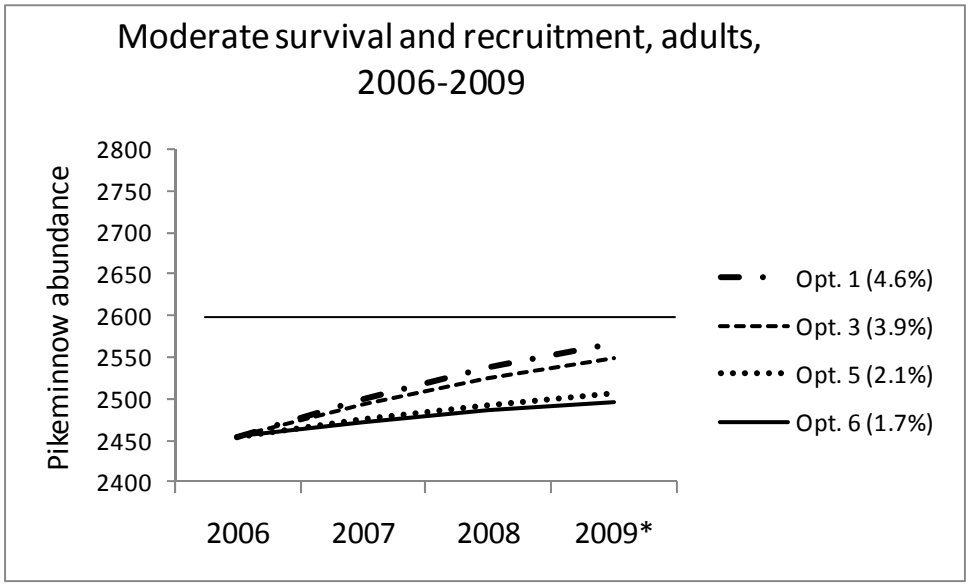
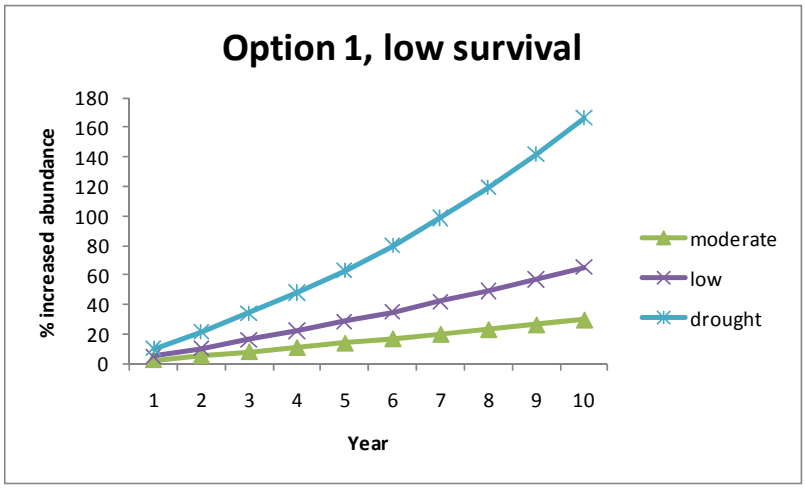
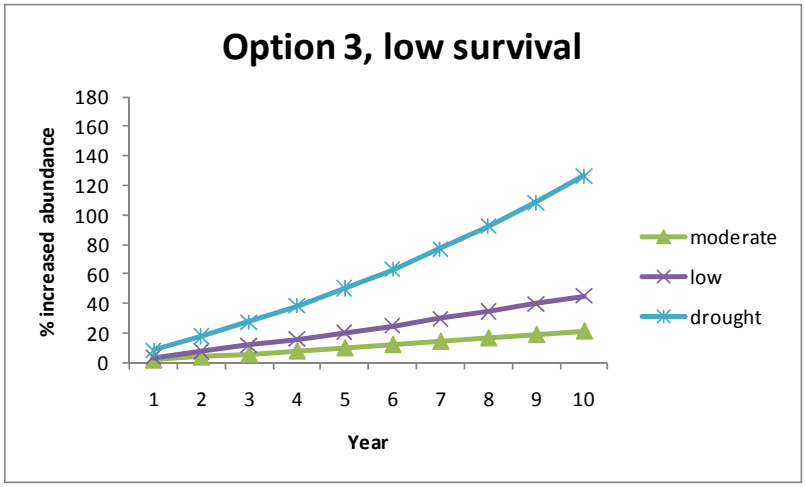


Figure 6. Changes in population size of Green River Basin Colorado pikeminnow due to various screening or turbine options implemented at Tusher Diversion. Initial population sizes were estimated from tag-recapture studies (n = 3304 in 2001, n = 2454 in 2006), as were survival rates for various life stages; changes in population trajectories reflect differences in recruitment and survival rates during the two estimation periods, 2001-2003, and 2006-2008; an additional year was added in each period to extend the trend.





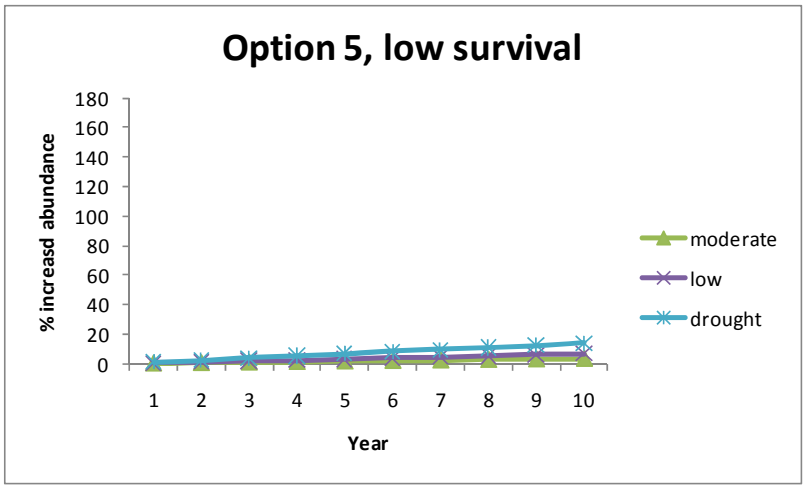
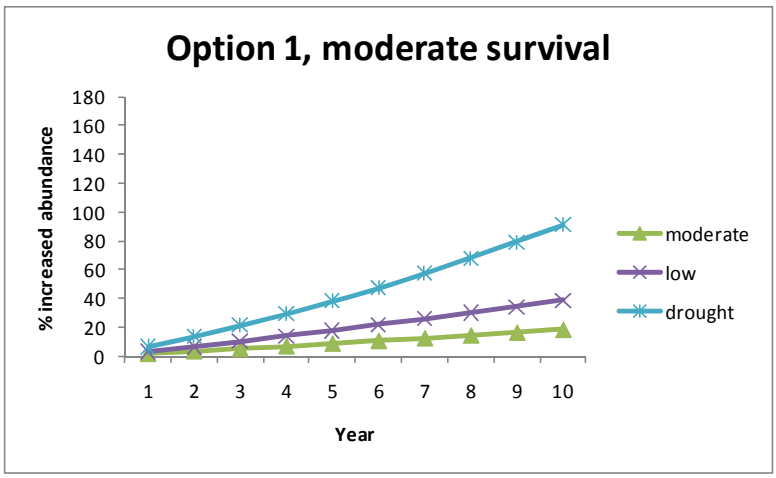
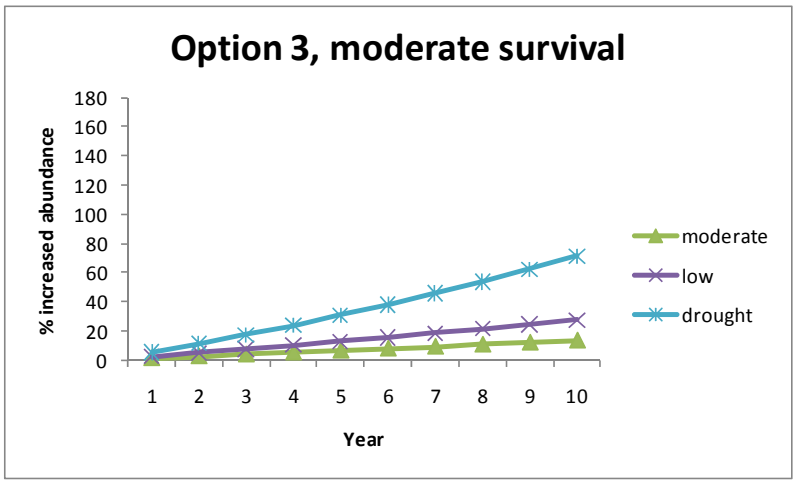


Figure 7 caption below, panels A-C (top to bottom) pictured here.





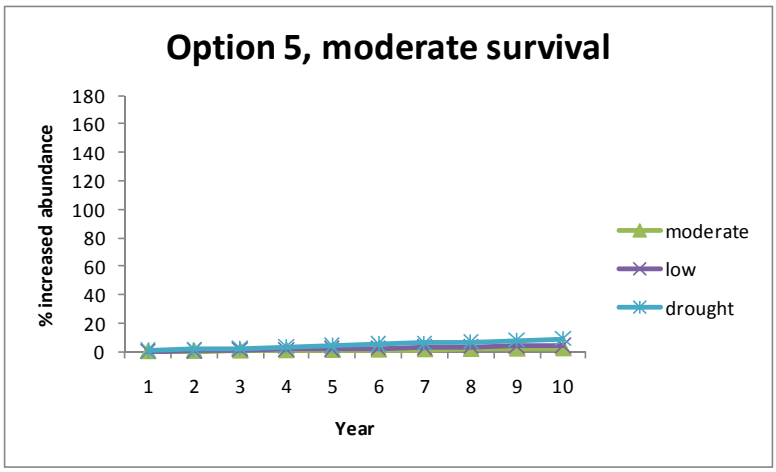


Figure 7 (panels A-F, panels D-F on this page). Scenarios portray % increases in populations subjected to various Tusher Diversion Dam modification options and represent the % increase *over* the level expected for the baseline condition of survival, 0.65 in the early low survival period (2000-2003) and 0.80 in the later moderately high survival period (2006-2008) over a simulated 10-year period. These were estimated for each of options 1, 3 and 5. Thus, the

baseline condition is not portrayed in the figures but would be a flat line across the bottom of the graph showing no increase over time. Only data for a low flow scenario are portrayed, which corresponds to an exceedence level of 85%; the drought scenario would produce higher % increased abundance levels and the moderate and high flow scenarios lower % increased abundance levels.

Literature Cited

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Bestgen, K. R., J. A. Hawkins, G. C. White, C. D. Walford, P. Badame, and L. Monroe. 2010. Population status of Colorado pikeminnow in the Green River Basin, Utah and Colorado, 2006-2008. Unpublished report to the Upper Colorado River Basin Endangered Fish Recovery Program, project 128. Lakewood, Colorado. Colorado State University, Larval Fish Laboratory Contribution 161.

Tyus, H. M. 1990. Potamodromy and reproduction of Colorado squawfish in the Green River basin, Colorado and Utah. Transactions of the American Fisheries Society 119:1035–1047.

----- Forwarded by Tom Czapla/R6/FWS/DOI on 12/09/2010 04:29 PM -----

"Norman Jr, Robert E. (Bob)" <RNorman@usbr.gov>

12/03/2010 01:21 PM

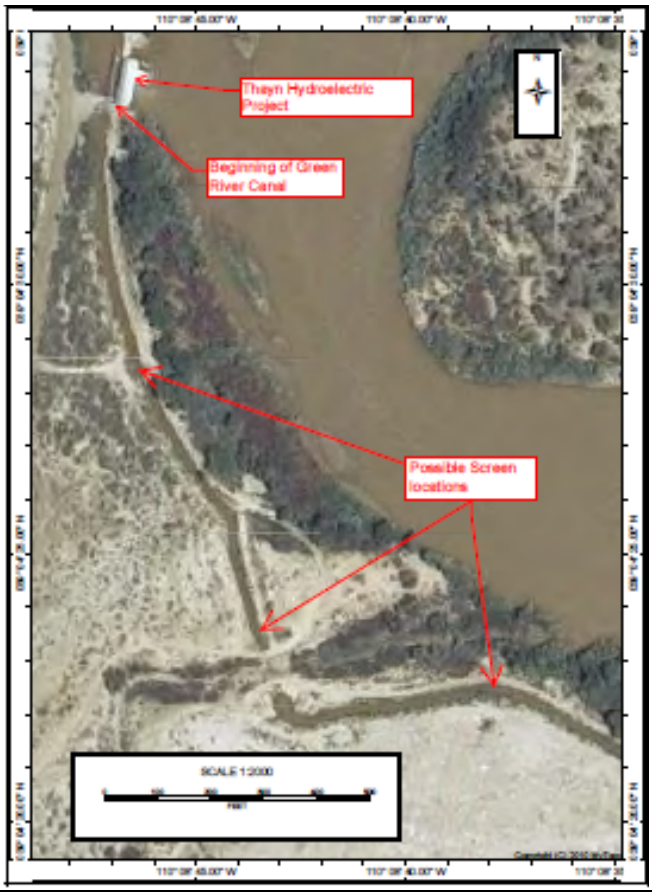
To "Bestgen,Kevin" <Kevin.Bestgen@ColoState.EDU>, "Czapla, Tom" <Tom_Czapla@fws.gov>, "Trammell, Melissa" <Melissa_Trammell@nps.gov>, "McAbee, Kevin" <Kevin_McAbee@fws.gov>, "Speas, David W" <DSpeas@usbr.gov>, "kbestgen@warnercnr.colostate.edu" <kbestgen@warnercnr.colostate.edu>, "Chart, Tom" <tom_chart@fws.gov>, "Kantola, Angela" <angela_kantola@fws.gov>, "krissywilson@utah.gov" <krissywilson@utah.gov>, Tom Pitts <tpitts@waterconsult.com>

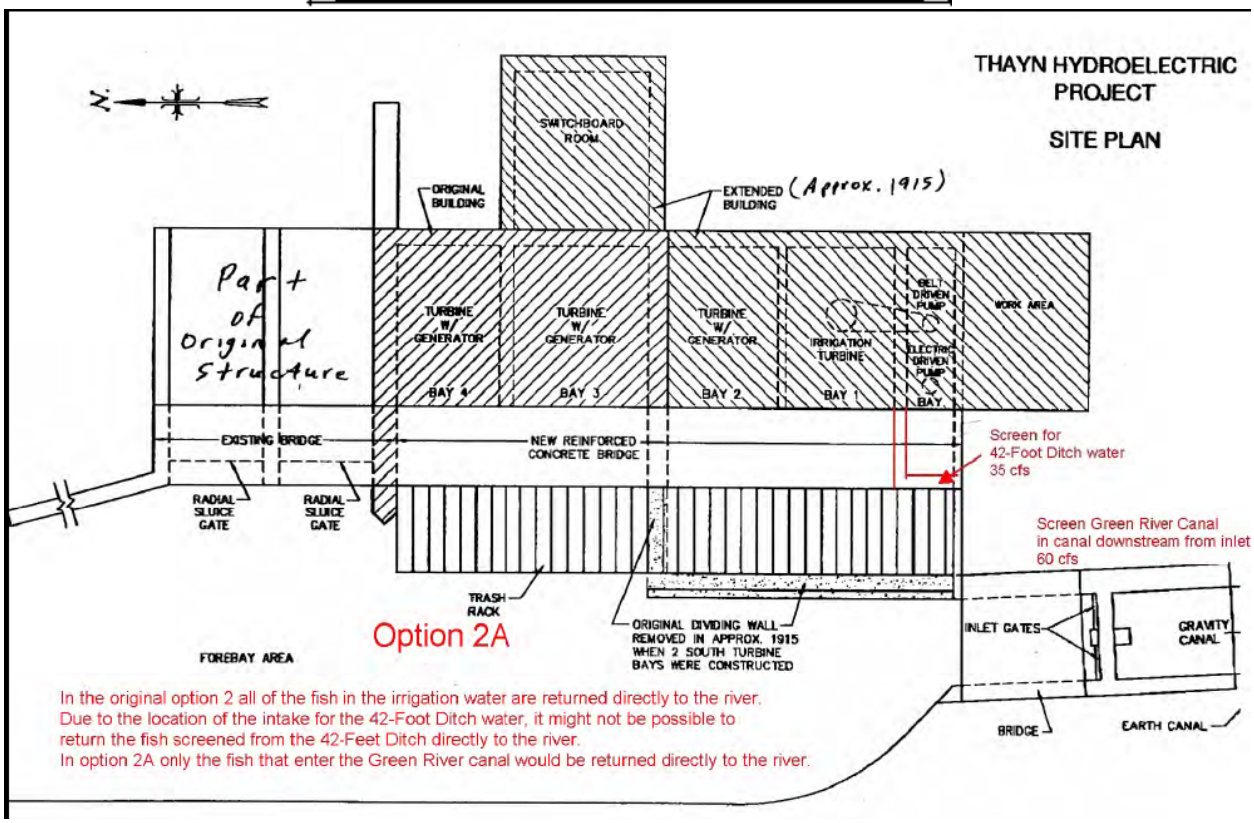
cc

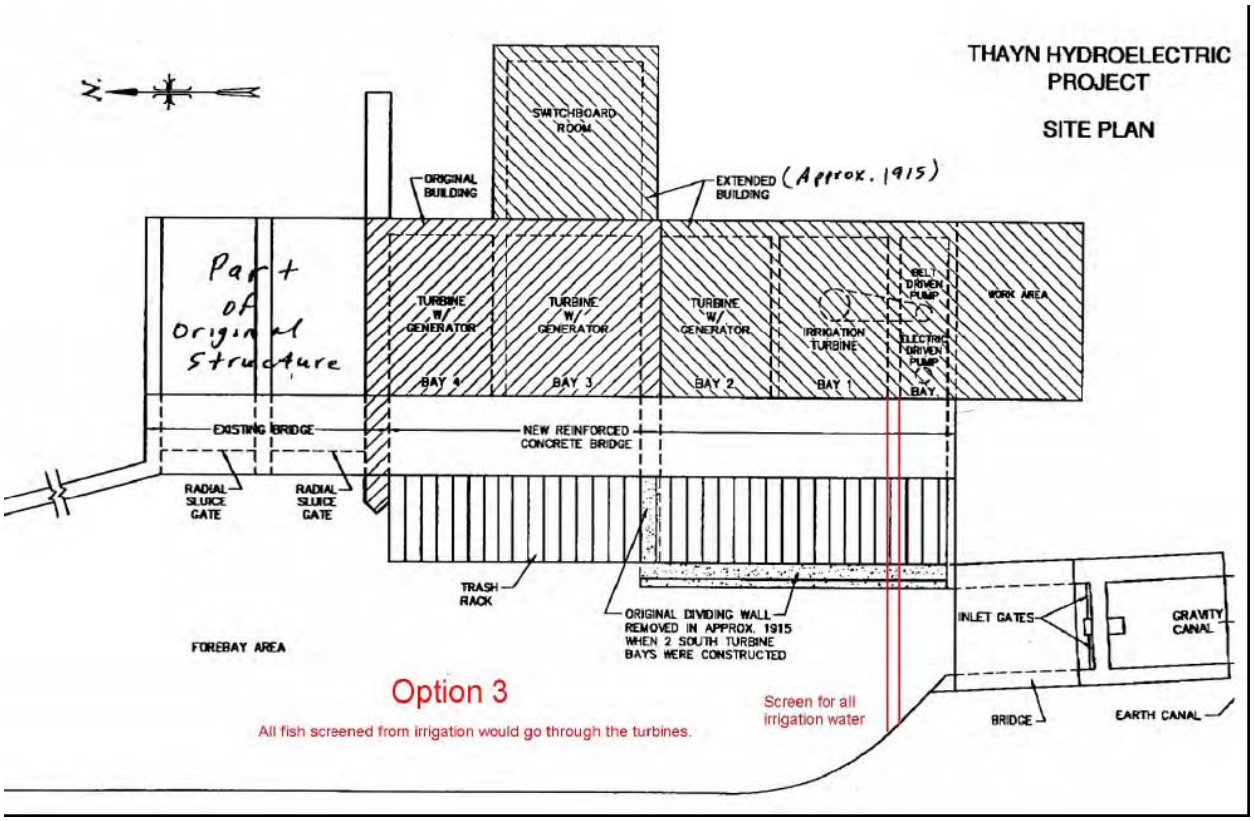
Subject 12/2 Call followup

All,
Kevin B and I talked this a.m. Yesterday I finally understood what Option 2 was in his option table. It would be possible to screen Green River canal company water down in their canal and return the fish back to the river. I've attached a aerial photo showing possible locations. Right now I cannot think of a way to screen the 35 cfs going to the 42-Foot ditch so that those fish could also be returned directly to the river. That is why I called it option 2A. We can keep the fish from entering the pump intake, but I can't think of a way to make them go back to the river rather than through the turbines. We could put a return channel or pipeline at the end of a screen, but what would keep them from turning around and going through the turbines?

I have also attached an image of the Thayn Hydroelectric site. In one version of the image, I show how option 3 could be implemented. In the other version, I show how 2A could be implemented.
Bob


Thayn Hydroelectric Project
Beginning of Green River Canal
Possible Screen locations
SCALE 1:2000


THAYN HYDROELECTRIC PROJECT
SITE PLAN
SWITCHBOARD ROOM
ORIGINAL BUILDING
EXTENDED BUILDING (Approx. 1915)
Part of Original Structure
TURBINE W/ GENERATOR
TURBINE W/ GENERATOR
TURBINE W/ GENERATOR
IRRIGATION TURBINE
BELT DRIVEN PUMP
ELECTRIC DRIVEN PUMP
WORK AREA
BAY 4
BAY 3
BAY 2
BAY 1
BAY
EXISTING BRIDGE
NEW REINFORCED CONCRETE BRIDGE
RADIAL SLUICE GATE
RADIAL SLUICE GATE
Screen for 42-Foot Ditch water 35 cfs
Screen Green River Canal in canal downstream from inlet 60 cfs
TRASH RACK
Option 2A
ORIGINAL DIVIDING WALL REMOVED IN APPROX. 1915 WHEN 2 SOUTH TURBINE BAYS WERE CONSTRUCTED
INLET GATES
GRAVITY CANAL
FOREBAY AREA
BRIDGE
EARTH CANAL
In the original option 2 all of the fish in the irrigation water are returned directly to the river.
Due to the location of the intake for the 42-Foot Ditch water, it might not be possible to return the fish screened from the 42-Feet Ditch directly to the river.
In option 2A only the fish that enter the Green River canal would be returned directly to the river.


THAYN HYDROELECTRIC PROJECT
SITE PLAN
N
SWITCHBOARD ROOM
ORIGINAL BUILDING
EXTENDED (Approx. 1915)
Part of Original Structure
TURBINE W/ GENERATOR
TURBINE W/ GENERATOR
TURBINE W/ GENERATOR
IRRIGATION TURBINE
BELT DRIVEN PUMP
ELECTRIC DRIVEN PUMP
WORK AREA
BAY 4
BAY 3
BAY 2
BAY 1
BAY
EXISTING BRIDGE
NEW REINFORCED CONCRETE BRIDGE
RADIAL SLUICE GATE
RADIAL SLUICE GATE
TRASH RACK
ORIGINAL DIVIDING WALL REMOVED IN APPROX. 1915 WHEN 2 SOUTH TURBINE BAYS WERE CONSTRUCTED
INLET GATES
GRAVITY CANAL
FOREBAY AREA
Option 3
All fish screened from irrigation would go through the turbines.
Screen for all irrigation water
BRIDGE
EARTH CANAL

Attachment 3

Memo

To: Biology Committee
From: Tom Chart, Director, Upper Colorado River Endangered Fish Recovery Program

Subject: Discussion with commenters and future process for research framework.

At the September 30, 2010, Biology Committee meeting, the Committee asked the Program Director's office to "meet with the environmental groups (and perhaps other commenters) prior to the Biology Committee discussion/review of the framework so that the Committee can have a fairly focused discussion."

On October 19, 2010, Tom Chart and Tom Czapla (Program Office) and Mike Roberts and Brandon Albrecht (representing the environmental groups) discussed by phone their comments and concerns on the research framework. Mike and Brandon recognized that perhaps from the start of this exercise, the expectations of a Research Framework (Res Frame) were varied. Mike and Brandon commended the Program for its self-evaluation, but were expecting more along the lines of research needs, i.e. going beyond identifying the problem. Mike and Brandon indicated that the comments they submitted on August 31, 2010 were pretty general and that they would be willing to submit a more detailed version if necessary. Chart and Czapla thought that was not necessary. However, Brandon and Mike mentioned that they supported many (if not all?) of the comments submitted by the FWS. In particular, they felt that the Research Framework in its present form does not provide adequate accounting of past research, i.e. the Research Framework would benefit from a more thorough citation of the available literature. Mike indicated that for someone relatively new to the Recovery Program (who does not share the institutional knowledge of the authors and the Program Director's office) the document in its present form fell short of describing how we got to where we are today. Regarding the Program's past track record, Chart and Czapla recognized that, unfortunately, the literature review / database portion of this Research Framework had gotten off-track and did not factor as heavily into the final product as well as the authors had hoped.

Chart mentioned that the three Recovery Program syntheses-in-progress (floodplains, backwaters, and smallmouth bass management) get to the heart of what he thought was the impetus for the research framework. More specifically, those data-mining exercises are intended to answer the question "Are we doing the right things in terms of flow (Green River) and nonnative fish (smallmouth bass) management to increase survival of young Colorado pikeminnow and razorback sucker (primarily) and humpback chub (secondarily)?" Also, via the Aspinall Study Plan, we may start to evaluate flow management in the Colorado sub-basin. Chart recognized that perhaps the Program is relying too heavily on institutional knowledge. Czapla and Chart have heard the same request for a more detailed retrospective analysis to help us plan future research and management actions from other partners.

How to proceed: All funds for this project have been spent, thus further changes would have to be absorbed by the Program office. Tom Chart thought the Program office could incorporate the specific comments, but is not certain that the other Program partners are willing to invest in the

deeper concepts that the environmental groups were thinking about. Mike said The Nature Conservancy may have some source funding if we want to continue this effort – whether that be further revision of this document or to launch a second Phase. Mike provided a copy of the Battle Creek Adaptive Management Plan, which serves as an example of the approach they are promoting for our Program. In later discussions, Mike mentioned that TNC also has a planning process (Conservation Action Plan) that may be useful for the Upper Basin Program. The San Juan Program recently used this facilitated process and Dave Campbell thought it was very worthwhile. (They are awaiting a final report at this point).

On November 24, Tom Czapla called Trina Hedrick (UDWR) to review her comments. She thought this project would be more specific as to research needs the Program is missing and reviewing past projects to identify future research needs. Czapla said it was supposed to identify areas that we may not be paying much attention to that are in need of research. Czapla thought her specific comments were good and the Program office would try to incorporate them in a final product.

On December 2, Tom Czapla called Doug Osmundson to review the Service's comments which he had compiled for those in the office. Doug had three overall concerns. 1) Not enough citations (Doug provided or identified where citations or a reference to the authors' personal communication are needed in his written comments). Doug thought that without adequate citations, statements may be assumed to be fact because they are in the report when they may just be the authors' professional judgment. 2) Doug couldn't always follow the logic as to how the authors identified certain controlling variables and not others. Czapla mentioned that he did not think we would be going back to the authors for to further flesh out their thought processes. 3) Doug suggested that more attention seems to have been given to Green River system factors than the Colorado River system, with the recognition that there are more data and a longer time frame available for the Green River system. Doug expressed concern that this could mean there will be no more research and everything just becomes monitoring. Czapla said there is still plenty of room for research, since we know very little about bonytail and we still have contaminants issues to resolve.

Recommendations / Options:

- Considering recent actions (synthesis efforts, 5-year reviews, Aspinall Study Planning) is there still a need to pursue the Research Framework? If not, the Program Office could incorporate the specific comments received to date into a final draft by the end of February.
- Expend some more time to develop the literature review / database component to provide better justification for the Research Framework recommendations.
- Recovery Program collaborates with TNC through their Conservation Action Plan. We should review the San Juan River product (perhaps TNC has others that might be more pertinent to our Program) to get a sense of expected outcomes.

Attachment 4

Recommendations from Nonnative Fish Workshop, 12/7-8/10 Grand Junction, CO
Biology Committee December 14 discussion reflected in italics.

#147: Standardization of Recovery Program Electrofishing Fleet

- Recommend field-testing a couple of ETS units in 2011, with one going to John Hawkins' crew. *BC agreed, if funds available. John's existing unit will go to UDWR. FWS also may need a new unit; >Pat Martinez will work with FWS to determine if this should be an ETS unit. Sherm also may get one of these units for Billy's work in the upper Yampa.*

- Cathodes should be positioned near the rear of the raft.

- Recommend that the raft electrofishing fleet adopt a fan-style cathode consisting of four strands of 0.25-inch diameter stainless steel cable of a length that allows 46-inches of each cable strand to be submerged in the water while trailing the raft. *>Pat Martinez will distribute design details to PI's.*

Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin

- Stocking plan, screening, and berming should be approved by the State Agency and FWS.

- Screens and berms should be inspected annually by State Agency. *Krissy said she didn't find this in the Procedures (and UDWR is not currently doing this); >Pat will ask Anita to identify where this occurs.*

- Recommendations: increase frequency of notices in local newspapers informing landowners that they are required to have a permit to stock fish. *This also should be on the Division's website (e.g., under updated, seasonal information in the spring).*

- Implement the 2009 revised Stocking Procedures and amend CDOW regulations to reflect the 2009 Procedures. *Sherm Hebein said that Harry Crockett will be working on revising the CDOW regulations to be in accord with the 2009 Procedures, with an anticipated effective date of January 1 (or possibly earlier by emergency regulation). Pat suggested having a HACCP instructor to come to Colorado and provide training to address the fact that in any aquaculture operation, the potential exists for "hitchhikers" in loads of fish. Sherm said CDOW has HACCP's for (Vicky Milano) all their facilities. Krissy said UDWR has these, also. Pat would like to get a copy of a state plan to provide to the private sector (>Sherm will send).*

C-18/19: Chemically Fingerprinting Nonnative Fishes in Reservoirs

- Collect otoliths from fish if you have suspicions or thoughts of investigating Sr rations (handle with non-metallic instruments, rinse with Milli0Q water, blot with clean tissue, store in labeled microcentrifuge tubes within well-labeled coin envelopes (species, TL,

capture date, water body, specific location [UTM helpful]). Analysis of 5-10 fish likely sufficient to fingerprint a stable location.

- Collect crayfish in selected reservoirs and in rivers at intervals downstream, then compare fish and crayfish SR ratios to establish river signatures. *This could be accomplished via amendment to the current SOW; >Pat Martinez will get a draft SOW amendment from CSU for the Committee's consideration (contingent on available funding), with sorting out the difference between Green River and Flaming Gorge Reservoir the highest priority. Shane asked if we've transitioned from research to application and how we'll provide this service in the future.*

125: Evaluation of Smallmouth Bass and Northern Pike Management in the Middle Yampa River + 2010 Cooperative CSU, CDOW, USFWS "Surge"

- Are there other techniques that would allow us to extend duration of removal into base flow (e.g., angling, smaller boats)? Brainstorm novel techniques. *These might be angling, rafts, etc.*

- Intensive removal also may need to be moved into other reaches. *(E.g., South Beach and Craig, as >to be determined by the "Team Surge" PI's, who will meet soon to consider these recommendations and revise SOWs as needed and provide those in advance of the January 24 Biology Committee web conference.) Part of the nonnative fish workshop discussion dealt with translocation costs versus applying funds to additional effort, etc. Discontinuing translocation would allow those funds to be applied to effort elsewhere.*

- John thinks we should continue "the surge" and suggested that there may be ways to extend coverage of the spawning period (e.g., if the Service could extend another two weeks).

- PI's need to have further discussion re: coordination, how to sample better at <1,000 cfs (e.g., after July 4). Rafts might be tried (they are effective in smaller areas). Hawkins said the bass spawning areas don't typically have other species present, so that would minimize the potential for harm to native fishes using the raft technique.

#110: Smallmouth Bass and Channel Catfish Control in the Lower Yampa River

- Potential may exist to do some small-bodied fish sampling on a last (7^{th}) pass; *The Biology Committee supported this recommendation from a native fish response perspective. Pat mentioned a separate humpback chub assessment might also be necessary; Tildon can provide a draft 2012 SOW for the Committee's consideration.*

FR-115: Project Title: Cumulative Effects of Flaming Gorge Dam Releases, since 1996, on the Fish Community in Lodore and Whirlpool canyons, Green River

- Continue to remove predator fishes and monitor fish community response to fish removal, flow and temperature monitoring.

- Evaluate flow or water temperature management to disadvantage smallmouth bass reproduction. *The Committee has previously discussed the potential for a specific SOW to evaluate effects of flow/temperature manipulation on smallmouth bass and young-of-year pikeminnow, so this may be considered for the FY 2012-2013 work plan.*

123a: Smallmouth Bass Control in the Green River

- Paul Badame suggested that a part of the Echo to Split 16-pass effort should perhaps be moved downstream. Tom Chart suggested making this contingent on what's being seen in the field. (PI's, BC to discuss details) *>UDWR and USFWS will discuss. Tom Chart asked that they also consider whether people and reaches would be available in the Upper Yampa. Perhaps Andre could shed light on how much of the exploitation rate would be lost if the final 5 passes aren't included, for example.*

123b: Nonnative Fish Control in the Middle Green River

- PI's recommend continuing 11 passes, focusing on bass concentration areas: 4 complete passes (each complete pass requires 8 days), *the remainder of the passes* concentrating on areas where they see more bass. If do population estimate, would require 12 passes (to include a mark pass). *Krissy recommended asking Andre how this would affect his analysis.*

- Concentration areas should be defined by a smaller scale.

- Continue removal from Duchesne down to Tabyago *(highest concentration area).*

126a&b: Removal of Smallmouth Bass in the Upper Colorado River between Price-Stubb Dam near Palisade, Colorado, and Westwater, Utah.

- Reallocate the Rifle to Beavertail Mtn. reach passes to increase removal passes in the Grand Valley.

Elkhead Reservoir: Smallmouth Bass Translocation from Yampa River

- Boyd identified smallmouth bass concentration areas in reservoir for 2011 - improved recapture effort would enable an abundance estimate.

- Also would like to do an intensive pike effort in October 2011.

- Questions we'd like to answer (Hawkins):

    - Does timing of stocking in relation to whether the reservoir is spilling or not play a role in whether fish escape?
    - Does tagging and translocation have an effect on fish behavior that makes those fish more likely to escape than resident fish?
    - Do certain size fish escape at a greater rate than others?
    - Have environmental conditions changed to encourage bass to move and be pulled into the spillway?

- Does the new dam entice fish into the spillway?
- Are resident fish escaping at the same rate as tagged translocated fish?

- Melissa proposed that the group make the technically-based recommendation that we act in a precautionary way for the endangered and native fishes and ***not*** translocate fish into Elkhead in 2011 even if we aren't able to determine the escapement rates and criteria by that time.

- Perhaps anglers could be paid for fish they remove from Elkhead.

<u># 161: Population dynamics modeling of introduced smallmouth bass, Upper Colorado River Basin</u> *Shane asked if it's time for the Nonnative Fish Subcommittee to begin interacting with Andre (in light of what Andre showed about our level of effort from his preliminary analysis at the workshop); >Pat Martinez will facilitate this. The Subcommittee would like to ask Andre questions about things like whether we can forego population estimates. Sherm asked the PD's office if they think what Andre has at this point is adequate (or modifiable) to present a model and analysis on the Yampa River smallmouth bass situation to CDOW's Director. Shane thinks we need to wait until Andre finishes his stock assessment model. The Committee discussed how we can incorporate Andre's results to date into the FY 12-13 work plan and the need for the Biology Committee to schedule enough time for discussion (including the PI's, as appropriate).*

- If >PI's could submit their data through 2010 to Travis within 6 weeks, he could export the 2009 and 2010 data to Andre as one unit in time for Andre to include those data in the model. *>Pat Martinez will send a reminder to the PI's this week regarding the deadline and format (with emphasis to those who are delinquent with 2009 data).*

- SOW time and funds considerations for incorporating 2009 & 2010 data. *Melissa asked if this can be done in time to provide input to the FY 12-13 work plan, which will be approved in late 2011.*

<u># 98a: Middle Yampa River Northern Pike Removal and Evaluation; Smallmouth Bass Evaluation and Limited Removal</u>

- Repeat "surge" and consider reallocation of effort to periods when pike catch rates are highest.

- Continue combined population estimate between 98a and 98b, including the well-synhronized effort achieved in 2010.

- Continue CDOW work to control upstream northern pike source populations.

- Maintain landowner contacts.

- Discontinue translocation to Loudy Simpson Pond. *Boyd noted that 5% of the fish translocated there in 2009 were re-captured in the river in 2010.*

- Need to reach conclusion on Loudy Simpson Pond berming? *>CDOW will address this through the Division and come back to the Biology Committee with their*

*recommendation for berming to keep pike **currently** in the pond from escaping. Pat Martinez noted that even with berming, the NNF Stocking Procedures probably would not allow **stocking** pike into a pond within the 100-year floodplain.*

<u># 98b: Translocation of northern pike from the Yampa River upstream of Craig, Colorado</u>

- The Service also recommends discontinuing Loudy-Simpson translocation.

- The Service recommends removing fish from Loudy-Simpson. *The Division noted that the upstream ditches would provide an avenue for reinvation at high flows, however (unless something could be done to prevent that). This is an item for future Division and Committee discussion.*

- The Service also recommends considering euthanizing, instead of translocating fish.

- Yampa SWA, only caught pike (23) in South Pond, but this area is of concern and we need to add riprap or find some other method to prevent erosion that will connect in future years. *This is another of CDOW's "bucket list" items.*

- Since pike aren't part of the Yampa Aquatic Mgmt Plan, Pat suggests going to depletion-only in Aaron's buffer zone. Kevin said an estimate does provide some picture of other things going on in the system (e.g., big pulses of fish), but it may be worth the tradeoff. However, doing a depletion estimate before runoff would sacrifice the number of fish caught. *Michelle suggested that we should at least be able to take the same approach on population estimates for nonnative fishes as we do for endangered fishes and not require them every year).*

- If the objective is to catch as many fish as possible, the Service would prefer to target a 2-week pre-runoff period where they will catch a lot of fish, and then go back in after runoff when they know they'll catch a large number of fish again. *The Committee recommends changing timing to maximize catch and no longer translocating these fish anywhere (will be addressed in the briefing/white paper, and if cost of translocation is addressed there, will discuss current costs versus expected cost of disposal without translocation).*

- Dave suggested looking at how abundance estimates and CPE compare to see if we could scale back estimates to only every few years.

- Pat said he sees population estimates in the buffer zone as irrelevant in light of the upstream "pike factory."

- Michelle S. agreed with Shane's recommendation to only make population estimates every few years, and focus on depletion in the interim years. *Deferred until Committee discusses northern pike synthesis.*

<u>CDOW –Upper Yampa Reservoir & Pond Removal</u> *This is another of CDOW's "bucket list" items to be addressed in March.*

- Tom Chart emphasized the need to address the source areas of pike.

- Dave Speas suggested the Biology Committee follow up what can be done in the upper Yampa

- Concern expressed about the walleye in Stagecoach

- Campbell: SJR Program uses capital funds for this kind of backwater habitat restoration.

- Michelle recommended the BC take an in-depth look at how the Program can help CDOW in the upper Yampa.

- Sherman suggested a photo characterization of the Yampa River (akin to what was done on the Colorado and Gunnison) might be helpful. *Bill Goettlicher (bgoettli@do.usbr.gov,(303/445-2275)of USBR and Jana Mohrman can provide insight as to how to best access and use those photos.*

- Dave Speas and Tom Chart said they think the 2008 aerial photography went all the way up to Catamount. (2008 aerial photo link sent to CDOW 12-10-10).

- Michelle said that other Service programs (e.g. Partners) might be able to help with berming work on private lands.

Northern Pike Discussion

- With regard to a smallmouth bass-style synthesis of northern pike data, we have limited resources.

- Need to assess whether can do population estimates only every few years, what information would be lost, etc.

- Also need to talk about RM 151 backwater and Yampa SWA ponds

#158: Assessment of Larval Colorado Pikeminnow Presence and Survival in Low Velocity Habitats in the Middle Green River

- Increase the number of backwaters blocked by different mesh sizes.

- Continue to block selected backwaters using various blocking techniques.

- Compare the Split Mountain drift net data and backwater sampling data to Echo Park.

- *Dave Speas said he thinks the recommendation was to expand from 6 to 12 sites. Melissa said she thinks we need to continue this work given that we also have concern about small nonnative fishes. Pat Martinez suggested refining the results to catch per area, as opposed to catch per backwater.*

150: Green River White Sucker Removal (see # 123b)

- Continue white sucker removal efforts in all projects using various sampling techniques and habitats, and perhaps increasing efforts in side channels later in the year.

- If future hybridization studies are warranted, conduct during the low-flow pass in early spring or fall.

- Need to recognize the importance of tributary systems (i.e. White River). Dave noted similar discussions this year at DFC about the importance of preserving parts of the watershed that are doing fairly well.

125: Carp & White Sucker Removal in Middle Yampa River

- Recommendation: continue this work, including the control-treatment approach in Little Yampa Canyon.

Defer these three to 2012-2013 work plan:

- Consider tagging carp and white suckers with floy tags for movement studies (would add more work).

- Consider PIT-tagging flannelmouth and bluehead sucker in LYC.

- Begin carp and white sucker removals in other locations.

#110 & 123a: Channel catfish, burbot and walleye in Green River

- Should determine the risk burbot pose for the native fishes. ~~Escapement from Flaming Gorge more likely through bypass tubes than turbines, but the latter probably isn't impossible.~~ *Determine mechanisms for potential escapement from the Reservoir. NNF Subcommittee will consider.*

- What are our critical control points for burbot in Flaming Gorge?

- Start saving otoliths. For walleye and burbot from the Green River. *For walleye, 5 per reach. If take whole head instead of otolith, can compromise sample labeling if not kept frozen. Michelle said they're capturing a lot more walleye in the Grand Valley, so should consider this in FY 12-13 planning. >Pat will see if we've gotten a signature from Lake Powell (Derek Elverud in Utah may already have otoliths archived.)*

Native and Nonnative Sucker Hybridization

- Different offices have been using a variety of keys and visual tools; those could be posted on the listserver to share or sent to Pat to review/compile.

Crayfish: Catamount Rusty Crayfish and other Crayfish Work

- Share identification information.

- Pat Martinez recommended becoming familiar with folks that have crayfish expertise and looking for additional funding sources (J. Gross; J. Carpenter; B. Johnson).

Nonnative Fish Database Formatting

- Perhaps each PI could set some standardized naming protocols (go to 3-letter species codes – CDOW?).

- What needs to be done is to finish a relational database that field folks can use for data input and get that delivered to the PI's (this will be time-consuming and is beyond the scope of André's work).

- PI's should review list and send Travis a list of any missing species.

- Aaron suggested we would be wise to have one repository for all PIT tag data.

- Data are due March 15 each year. If Travis hasn't received data, he needs to tell the Program Director's office. Tom Chart suggested that if data need much cleaning up, it should go back to the PI's.

The Committee recommended that the Nonnative Fish Subcommittee discuss and distill workshop recommendations before they come to the Biology Committee in future years.

Attachment 5

Elkhead Reservoir (EHR) Smallmouth Bass (SMB) Translocation

EHR SMB Fishery

Short growing season for SMB in EHR.
Slow growth of SMB in EHR.
Limited recruitment of SMB from natural reproduction
EHR forecasted to have limited suitability for SMB
Currently supplemented with translocated SMB
Present SMB population likely reliant on translocation for population increase assuming escapement does not represent significant source of "loss to population", reducing adults for reproduction and recruitment.
Stopping translocation will slow and may arrest SMB population growth in EHR to the benefit of native fishes in YAR.
SMB bioaccumulate Hg; human consumption implications.

River Population

Prolific SMB reproduction
Periodic strong SMB year classes
Consumption of small-bodied native & endangered fishes by SMB
SMB hyperpredation on small-bodied fishes due to availability of virile crayfish
SMB entrenched in habitat & food web
SMB bioaccumulate Hg; human consumption/translocation implications.

Invasive Species Principles

EHR = point source for SMB & NOP
SMB & NOP now non-point in YAR main-stem
Translocation ignores addressing point source – actually sustains & perpetuates this source
Translocation violates prevention principles of invasive ecology & management.
Translocation given escapement ignores ecological transformation of native fish food web
Translocation contributes to existing propagule pressure, represents a source for recolinization if indeed headway is made in reducing SMB abundance, and adds propagules, sustaining or increasing pressure for downstream reaches or in other rivers.
Percent escapement approach does not account for SMB propagule pressure or SMB proliferative/invasive capacity.

Escapement

SMB escapement from EHR now chronic; public trust and fiscal responsibility of YAR native fish restoration undermined by resident SMB in YAR coupled with and SMB source and escapement from EHR sustaining propagule pressure and predation.
SMB long-lived (up to 15 years); persistence and escapement sustain/increase propagule pressure and predation on small-bodied native fishes.
EHR spills more often and longer than formerly expected following enlargement.
Cost & dam safety preclude spillway screen
Downstream weir durability, function or funding questionable
SMB in YAR demonstrably negative for native fish & recovery
Escapement of SMB from EHR given known invasive capacity and negative food web impacts of SMB in YAR violates Stocking Procedures and sets precedent for applying Procedures to future public and private stocking.
Current scenario: Breton tagging synthesis/escapement evaluation needed to determine if translocation should continue, not whether it should stop. Moratorium is required to limit

recurrence of propagule pressure in reaches from where SMB were removed and to prevent further progress toward reservoir SMB carrying capacity which would increase and ensure perpetuation of escapement.
Tagged fish have lower probability of recapture; recapture of tagged SMB that escaped EHR following translocation more improbable, increasing contribution of individual in estimation of the number of translocated SMB escaping EHR.
Translocation evaluation decision point: how can recovery & prevention of further listings proceed with chronic source of SMB escapement sustaining/increasing propagule pressure in YAR & GRR subbasin rather than why should translocation be under moratorium due to unknown impacts to native and endangered fish prospects?

Yampa River (YAR) Northern Pike (NOP) Buffer Zone

Buffer Zone Concept

Buffer Zone in YAR between Hayden and Craig (38 RM) to undergo intensive NOP removal to reduce number of NOP moving downstream into critical habitat.
NOP reproduction, recruitment and escapement upstream of and within Buffer Zone demonstrated to be source population of majority of NOP numbers in critical habitat.
Buffer Zone serves as an "instream screen" to lessen downstream immigration of NOP.
Release of NOP captured in Buffer Zone for any reason reduces efficiency and effectiveness of Buffer Zone concept and "screen/barrier function", thereby allowing long-lived, reproductive piscivores that demonstrate a propensity to move downstream into critical habitat to persist in YAR adding to predation impacts to native fishes in critical habitat.
Depletion population estimate in conjunction with NOP removal in Buffer Zone or reliance on CPUE and population structural indices continue to provide information for examining population trends for abundance, reproduction and recruitment.

River Population

High density NOP population
Suitable environmental conditions for NOP growth, condition, reproduction and recruitment in Buffer Zone and upstream in river, floodplain ponds and reservoirs.
NOP prey on native species in buffer zone
NOP move downstream into critical habitat; predation on native and endangered species confirmed.
No bag or size limits for NOP in YAR or its floodplain ponds or basin reservoirs provide message to public of preference by agencies that NOP in YAR to be managed for removal/suppression/eradication.

Relation to Recovery

Any hastening of NOP reduction in abundance beneficial to reduction of predation and propagule pressure downstream.
Bioenergetics modeling project substantial predatory impact of 100 NOP @~600 mmTL @ 10 lb prey/year = 1,000 lbs.