

**Glen Canyon Dam Technical Work Group
Proposed Science Topics to be considered at the
GCDAMP Annual Reporting Meeting January 28-29, 2014
for GCMRC review
December 16, 2013**

Project A. Sandbars and Sediment Storage Dynamics

1. Report on progress being made to determine if the new HFE protocol will:
 - a. result in net increases in sandbar area and volume;
 - b. whether this approach of using repeated floods to build sandbars is sustainable with the available sand supply (i.e. tributary inputs); and,
 - c. whether multiple high flows conducted over a period of 10 years will result in net increases in campable area along the Colorado River?
 - d. Will we be able to answer these questions in the timeframe outlined in the HFE protocol? (WAPA)
2. Provide some additional information on recent HFEs and sediment:
 - a. What are the results of the 2013 HFE? (GCRG)
 - b. How did the 2013 HFE compare to prior HFEs? (Nevada)
 - c. What do the recent HFEs tell us about the long-term predictions for sediment in the Grand Canyon? (GCRG)
 - d. The 2013 HFE left behind a lot of sediment. How will that be taken into account when a 2014 HFE is considered? (GCRG) This is different from past HFEs, leaving so much sediment behind in the channel, what might we expect as a result of this? Perhaps less erosion of sand bars (due to higher sediment loads in the mainstem or broader footings for the sandbars?) (WAPA)
3. What progress has been made on the work that Gram's has done looking at sand bar changes post-HFE? This was presented at a TWG meeting, but has been a work in progress. Are there any updates? (WAPA)
4. Were there any benefits to the shaping of 2012 HFE hydrograph (reduced time on peak and slower downramp)? Is there any need to further experiment with hydrograph shape in order to modify the structure of sand bars built during HFEs to make them more durable? (WAPA)
5. Provide a short presentation on how sediment samples are processed. Explain why it takes so long to process a season's worth of sediment samples. Where is the choke point for getting samples processed in a timely manner? Is there a way to make the process more efficient? (WAPA)

6. What is being done to develop, analyze, and implement an appropriate flow alternative to prevent sediment mass balance loss during flow equalization periods? (GCWC)
7. Clarify sediment flux in the Glen Canyon Reach and develop management recommendations to mitigate erosion. (GCWC)
8. Provide a report on the progress in expanding the sediment monitoring below Diamond Creek as requested by the Hualapai Tribe. (CRAHG)

Project B. Streamflow, Water Quality, and Sediment Transport in the Colorado River Ecosystem

Project C. Water-Quality Monitoring of Lake Powell and Glen Canyon Dam Releases

1. What are the differences in water quality of Glen Canyon Dam releases made during lower reservoir elevations? Are there any impacts we should expect or be looking for in the future based on the potential for continued low reservoir conditions (e.g., nutrients, low dissolved oxygen)? (WAPA)

Project D. Mainstem Humpback Chub Aggregation Studies and Metapopulation Dynamics

1. Provide an update on the aggregation sampling (Project D.1). Are we doing enough to understand the relationship between translocations and aggregation populations? Is the sampling program safe for the smaller aggregations (are there research impacts)? Are we picking up and tracking any movement between aggregations? If the number of fish in the aggregations starts to increase, will humpback chub end up returning to the Little Colorado River? Is there any evidence of long range movement that would tell us about the population structure of chub throughout the canyon when compared to the Little Colorado River? (WAPA)
2. Provide an update on determining natal origins of humpback chub at aggregations using otolith microchemistry (Project D.2.2). Have any otoliths been run yet? If so, is there any indication of mainstem spawning or spawning anywhere but the Little Colorado River? Has the antenna array in the Little Colorado River been useful in tracking these movement patterns? Will there be any publication of data soon? (WAPA)

Project E. Humpback Chub Early Life History in and Around the Little Colorado River

1. What are the implications of outmigration of juvenile humpback chub from Little Colorado River, especially related to monsoon events (Project E.1)? Does outmigration have an impact on recruitment to the adult population or are the long-term dynamics of the chub population buffered against these potential mortality events? Are juvenile chub survival rates (from JCM) highly affected by monsoon events? If so, what does this mean to our ability to make determinations about the impacts of temperature and trout to juvenile chub survival? (WAPA)

2. What are the drivers of good year-classes of humpback chub in the Little Colorado River (Project E.3)? Can we predict good year classes based on environmental conditions (e.g., Little Colorado River flow, temperature, food availability)? (WAPA)
3. Do HFEs transport juvenile humpback chub downstream and if so, what becomes of these fish? Do they survive at some downstream location? Are they moved to unfavorable or favorable habitats? Do they find food, or are they eaten by predators? Could they contribute to the aggregations? Do they return to the Little Colorado River population? A study of the fate of these fish is needed to fully assess the impacts of HFEs. (UAMPS/CREDA)

Project F. Monitoring of Native and Nonnative Fishes in the Mainstem Colorado River and the lower Little Colorado River

1. Provide an update on nonnative species observations (rainbow trout, brown trout, striped bass, and smallmouth bass) in the mainstem surveys (Projects F.1 and F.2). What nonnative species are of paramount concern for the long-term persistence of native fish in Grand Canyon and what should we be considering to ensure that the species that are established are managed effectively and those that are rare don't become established? (WAPA)
2. Provide an update on the rainbow trout monitoring in Glen Canyon (Project F.2).
 - i. Provide an update on the large cohort from the 2011 equalization flows. Is there an indication that this large cohort adversely affected the fishery by competing with larger trout? Is there a decrease in adult trout condition with an increase in small trout abundance?
 - ii. What was the affect of the Fall 2012 HFE on the Lees Ferry trout fishery and why? Did the Fall 2012 HFE affect the survival of the 2013 cohort, condition of larger trout, or dispersal (Project H.5), or the foodbase (Project F.7)? Do Fall HFE's have a similar affect on the trout fishery and the foodbase as Spring HFEs? What would sequential Fall and Spring HFEs do to the trout fishery and foodbase? (IFF)
3. How can we synthesize information being collected by the Juvenile Chub Monitoring (JCM) project so we can determine how juvenile chub survival (Project F.3) relates to trout abundance (rainbow vs brown; Project F.3), how trout and native fish interact under different environmental conditions like river temperature and turbidity (Project G.1), and foodbase availability (Project F.7)? What are the driving mechanisms for mainstem humpback chub numbers and their recruitment to the adult population at the Little Colorado River? (WAPA)
4. Provide an update on the development of a more robust ASMR model or the development of an LSMR model (Project F.4)? This is a high priority for the program; please bring us up to date on the latest developments of this population modeling. (WAPA)
5. Can we yet describe the utility of the translocation program (Project F.4.3)? How have these efforts improved the situation for humpback chub in Grand Canyon? Are these efforts increasing recruitment or bolstering numbers in the aggregations? Especially with

respect to the Little Colorado River/Chute Falls translocations, what is the definition of success with regard to these efforts? (WAPA)

6. Provide an update on results of the Natal Origins of trout study (Project F.6). What were the findings from this year? What movement was observed? Has our opinion of how the system works changed? Was there substantial production of trout in Marble Canyon the last few years (evidence of age 1's in Marble Canyon but little downstream movement detected)? For the next few years, based on what we have learned about movement, are there any changes that need to be made to the Natal Origins study? Will the large Fall 2013 sediment input into Marble Canyon have an impact on the large population of trout currently in Marble Canyon? Will we be able to detect increased movement downstream to the Little Colorado River reach because of a reduction in habitat quality for trout in Marble Canyon? (WAPA)
7. Provide an update on what is happening with trout/chub numbers and the triggering criteria for the 2011 Biological Opinion. (CRAHG) Should the criteria be updated with new numbers, such as the brown trout numbers? Are these reasonable practical numbers that relate to effects on humpback chub in the mainstem? Describe the relationship of the trout numbers in the Biological Opinion to what the trout population would be in the entire Little Colorado River reach (density, total population) and how that relates to previous Little Colorado River reach population numbers (e.g. removal numbers and population estimates from previous removal efforts in Coggins et al. 2011). (WAPA)
8. Provide a clarification of the latest GCMRC foodbase fact sheet (Kennedy et al. 2013):
 - a. Kennedy et al. makes the following statement in their fact sheet on page 4:

If increased native fish production is desired in Marble and Grand Canyons, other management actions could be considered. For example, hydroelectric power generation from Glen Canyon Dam causes large daily changes to the Colorado River's discharge and lowers algae production relative to more stable discharges (Robert Hall, Jr., and others, unpub. data, 2013). Thus, stabilizing the discharge regime could lead to increased algae production at downstream sites, which may in turn have positive effects on invertebrate and fish production.
 - b. But previously, it is stated that algal production decreases from Glen to Marble Canyon and is even lower in Grand Canyon (Hall and others, 2010), because the higher suspended sediment load reduces light penetration. The foodbase at RM61 and below (where all the humpback chub and other native fish are located) is primarily detritus based, not algae based.
 - c. So wouldn't taking steps to increase algae production with more stable discharges from Glen Canyon Dam have a positive effect only on invertebrates and fish production in Glen and upper Marble Canyons? Aren't these areas dominated by rainbow trout and not by native fish?
 - d. If so, wouldn't a more stable flow regime actually end up having a negative effect on humpback chub and other native fish in Marble and Grand Canyons due to increased competition and predation by rainbow trout?
 - e. Are there other strategies that might be discussed, such as nutrient augmentation in critical reaches of the river, which might increase food base productivity even

in the more turbid portions of Marble and Grand Canyons where native fish are predominately found? (WAPA)

Project G. Interactions between Native Fish and Nonnative Trout

1. Provide update on evaluating the effects of trout predation and competition on humpback chub (Project G.1). What is the primary driving force for juvenile chub mortality (temperature, predation by rainbow and/or brown trout, cannibalism, etc.)? Does turbidity reduce the predation pressure on juvenile humpback chub? (WAPA)
2. Provide an update from the Fall 2013 brown trout mainstem removal trip. How do removals of trout in Bright Angel Creek by the National Park Service relate to mainstem removals of brown trout by GCMRC (Project G.2)? How do these removal efforts affect humpback chub and observations of brown trout in the Little Colorado River reach? Are we near the 2011 Biological Opinion trigger for brown trout removal in the Little Colorado River reach? What do we expect to see with the mainstem brown trout removals at Bright Angel Creek over next few years? (WAPA)
3. How much more do we need to know about the chub and trout to know enough to be sure the chub will remain viable and the trout will do well but not be out of control? What studies still need to be done to get to these answers? (GCRG)

Project H. Understanding the Factors Limiting the Growth of Large Rainbow Trout in Glen and Marble Canyons

1. Have we learned anything more about the trout strain at Lees Ferry (Project H.1)? Are these fish capable of growing BIG, or are they now genetically “stuck“ in a more moderate size class? (WAPA)
2. Provide an update on the tailwater synthesis project (Project H.4). What have been the major findings with regard to environmental conditions, invertebrates species found, and their abundances in tailwaters similar to Glen Canyon? What is working in those tailwaters that is not working in Glen Canyon? (IFF)

Project I. Riparian Vegetation Studies: Response Guilds as a Monitoring Approach, and Describing the Effects of Tamarisk Defoliation on the Riparian Community Downstream of Glen Canyon Dam

1. How does monitoring tamarisk beetle defoliation and arthropod/pollinator abundance relate to GCDAMP goals and information needs? How does this relate to management actions at Glen Canyon Dam? Provide a review of riparian vegetation-related science questions and information needs identified by the GCDAMP. Identify those areas that Project I is helping the GCDAMP resolve those science questions and information needs. (WAPA)
2. What is being done to develop a Colorado River ecosystem conceptual model that couples aquatic and riparian domain processes by integrating river continuum and riparian landform/habitat modeling? (GCWC)

3. Clarify the potential impacts and management alternatives related to the system-wide loss of tamarisk. (GCWC)
4. What is being done to develop a model of riparian vegetation development in relation to dam operations? (GCWC)

Project J. Monitoring of Cultural Resources at a Small Scale and Defining the Large-Scale Geomorphic Context of those Processes

1. Provide a review of cultural-related science questions and information needs identified by the GCDAMP. Identify those areas that Project J is helping the GCDAMP resolve those science questions and information needs. (WAPA)
2. What is being done to evaluate the impacts of operations at Glen Canyon Dam on cultural resources in Glen, Marble, and Grand Canyons in Projects J.1 and J.2? What are the areas of concern and how are tribal values being addressed in the management of cultural resources? (WAPA)
3. Have GCMRC report on their cultural resource monitoring program and progress they have made toward successful integration of Tribal values into that program. (CRAHG)
4. TEK and Tribal Input: almost every meeting this topic comes up. We sense there is some real frustration on the tribal side that they are not getting heard. Could we address this issue so it can be satisfactorily resolved for the tribes? (Nevada)
5. Develop a list of species of management concern to the participating Tribes, and use that discussion to clarify how to better incorporate traditional ecological knowledge into CRE science and management programs. (GCWC)
6. Have Grand Canyon National Park provide a presentation on their monitoring of archaeological sites (and other historic properties) that is part of their on-going Colorado River management plan. (CRAHG)
7. Have Grand Canyon National Park provide an update report on when the CRAHG may be provided an opportunity to review the data recovery report that details the excavations that the Museum of Northern Arizona and Grand Canyon National Park performed in 2010. (CRAHG)
8. Have Glen Canyon National Park Service report on the progress made at the -9 Mile terrace site. (CRAHG)
9. Does Lidar work to monitor cultural sites? Should its use be expanded from Glen Canyon to other sites in Marble and Grand Canyons? (WAPA)
10. What is the future of the cultural resources program (both GCMRC's cultural resources program and Reclamation's compliance under the programmatic agreement) within the GCDAMP? Recent events might suggest that the cultural resources are losing importance in this program, which would be ironic given that the entire GCDAMP is a product of a cultural resource value. (CRAHG)

Project K. GCMRC Economist and Support

1. Socio-economics. We'd like to meet the new economist and hear about what's in the works on that front. (GCRG)

Project L. Independent Reviews and Science Advisors

1. What is the current role of the science advisors at GCMRC? Are they doing program reviews as in the past or have we changed direction? What does GCMRC see as the utility of the Science Advisors, what reviews are planned for FY15-16? (WAPA)
2. We have been on a 5-year schedule for peer reviews of the various programs (e.g., PEPs). What are the plans for PEPs in FY15-16? (WAPA)

Other:

1. Provide update on Kanab Ambersnail designation and publications.
2. The material that is presented at the January knowledge assessment meetings is very informative. Let's not wait to get the power points and presentation materials disseminated to our group two months later. Could we identify the documents as "Preliminary" and get them on the GCDAMP Wiki site the same day. Later, once they are finalized, then "officially" post them on GCMRC's website. (Nevada)