# Glen Canyon Dam Adaptive Management Program

# Technical Work Group: Budget Ad Hoc Group

Conference Call #4, March 20, 2017 – Meeting Notes

## Attendees

The following people identified themselves as being on the call.

Cliff Barrett, UAMPS

Shane Capron, WAPA and BAHG chair

Marianne Crawford, Reclamation

Bridget Deemer, GCMRC

Craig Ellsworth, WAPA

Helen Fairley, GCMRC

Katrina Grantz, Reclamation

Paul Harms, New Mexico

Christopher Harris, California

John Jordan, Anglers

Ted Kennedy, GCMRC

Michael Moran, GCMRC

Jessica Neuwerth, California

Clayton Palmer, WAPA

Peggy Roefer, Nevada

Randy Seaholm, Colorado

David Ward, GCMRC

Scott Vanderkooi, GCMRC

Charles Yackulic, GCMRC

The following were not on the call:

Melinda Arviso-Ciocco, Navajo Nation

Janet Balsom, NPS

Carlee Brown, Colorado

Chris Budwig, Anglers

Kathleen Callister, Reclamation

Kerry Christensen, Hualapai

Kurt Dongoske, Zuni

Brian Healy, NPS

Leslie James, CREDA

Vineetha Kartha, Arizona

Ryan Mann, AGFD

Don Ostler, New Mexico and Wyoming Jenny Rebenack, NPS

Ben Reeder, GCRG

Dave Rogowski, AFGD

Seth Shanahan, TWG Chair

Chris Schill, USGS

Larry Stevens, GCWC

Rosemary Sucec, NPS

Mike Yeatts, Hopi

Kirk Young, USFWS

Mary Orton of The Mary Orton Company, LLC attended as facilitator and note-taker.

Shane noted that today’s subjects for presentations from GCMRC staff are Nutrients, Humpback Chub (HBC), and Foodbase. He asked Katrina if she would like to present on the Reclamation budget, and she asked to present at the next meeting.

## Nutrients

Bridget Deemer said they had an extended abstract that describes an ecosystem-based system: nutrients and temperatures operate together in food web dynamics, primary production, macroinvertebrates, and fish. They are proposing to take a number of different approaches:

* A background characterization of the river, looking at the dam vs. tributaries in terms of overall nutrient budgeting.
* Continuing some previous work on modeling primary production: how nutrients and temperatures influence the rate at which plants can produce biomass for the rest of the food web.
* How Lake Powell influences nutrients in river, which they believe is the most important.

Charles Yackulic said they have been working on an improved temperatures model because the past model under-predicts temperatures downstream by about 2 degrees on average. They think they are developing an improved model. That would be worked on early in the work plan. Other areas include:

* Inexpensive work on aquatic vegetation composition that Mike Yard has been working on. This involves how to monitor vegetation composition over time, particularly in Lees Ferry.
* Moving modeling toward an ecosystem approach, working more with temperatures and nutrients and how they affect lower trophic levels. It is important to make predictions about how the Colorado River Ecosystem (CRE) responds to reservoir conditions, such as temperatures regularly above 16 degrees.
* How quagga mussels might affect nutrients, with a focus on phosphorus and temperatures as key levers.
* Using mesocosms, where they replicate a smaller version of the river in fiberglass raceways. They will use Colorado River water to see how vegetation and bugs respond to different phosphorus levels and EPTs[[1]](#footnote-1) and looking at higher trophic levels. They would take rocks, algae, and plants from the CRE, put them in raceways, and then see what is favored if temperatures increase, or phosphorus is doubled, or other changes are introduced. This could show where the system could go in the next 10-20 years. They will also look at nutrient stoichiometry: they could drip in nutrients, paying attention to how much as well as how much in relation to other nutrients.

Shane invited questions and discussion from attendees.

* Is the temperature model like the one used by Robert Radtke at Reclamation?
  + This model is not for the reservoir; rather, it is about predicting temperatures downstream. The current one doesn’t do well in the hot months far downstream from the dam. It consistently under-predicts in hottest months by 2 degrees C, so we think we can have an improved model.
* I like the idea of mesocosms. Are you bringing in invertebrates or letting them colonize themselves?
  + We might transplant mudsnails and gammarus from the river. We will need to count them out. We might, for example, add 100 of each type to each stream, and control for the numbers, so can make inferences about growth rates and abundances under different conditions.
* As you gather this information, which would be very helpful for determining importance of a TCD, can you tie it into how that information would help adjust dam operations to improve the situation? This would give us an idea of how the ecosystem works and also the potential for adjusting dam operations
  + We are always motivated by those questions of dam operations here. It is possible that some things we ascribed to flows in the past are more driven by nutrients. For example, we think equalization flows affected RBT, but that year phosphorus was high in the system. I don’t know what you might do to control that. There is some discussion of putting turbines on lower outtakes to control for different nutrients. Our current understanding of flows is affected by our ability to control for other factors that might be more important. It’s not that flows are not important; sometimes they are very important. However, other impacts that we thought were due to flows might be due to nutrients. Equalization always happens with big inflows into Lake Powell, and we think those are connected with phosphorus. The idea of TCDs and the ability to affect nutrients is fascinating. We hope to understand the mechanisms better with the Lake Powell work. Previous work done shows, in both Lake Powell and other reservoirs, if you spill water from lower in the water column, it changes nutrient levels.
* Please suggest ideas for alternative reservoir operations that should be investigated.
  + A lot of our work is based on how to operate the dam to improve things.
* Are you addressing improving our understanding of what comes in as nutrients from tributaries such as the Paria, and how to take advantage of that with dam operations?
  + A lot of carbon from tributaries is older carbon, which is not as useful. We find as we move downstream, there is more and more terrestrial detritus in food web, but ultimately it is driven by algae production. Our working hypothesis is that output from Powell is dominant, but we are also looking at Paria and Little Colorado River (LCR) inputs. Maybe during monsoons, the LCR could be significant source of nutrients, but there is none during low flows. We need to look at storm events. The Paria watershed doesn’t have the same source of land use you associate with higher phosphorus input.
  + At the Annual Reporting Meeting (ARM), we said it looked like the dynamics at the LCR were driven by dam operations; however, during floods, both LCR and Paria can provide significant amounts of nutrients. How long do they stay in the system? If it leaves quickly, it may not be able to be used for more than a few weeks. These are all hypotheses.
  + Ted Kennedy: We are developing nutrient budget in the work plan. This will be a simple tool for looking at what is coming out of dam, and will put the tributaries floods into context. Nutrients might spike during a flood but move quickly out of system, is my guess. Year over year, what is coming from the dam is what is important for affecting fish populations. We want to better understand nutrients and how affecting food web dynamics.

## Humpback Chub

Charles Yackulic said that, motivated by the Long-Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) and Biological Opinion (BO), they were probably going to propose three main groups of activities.

1. Ongoing long-term studies.

Charles said they are proposing here to continue population modeling with added improvements. Specifically they will integrate new forms of portable remote antennae. In the mainstem, this would improve their ability to estimate the population of larger adult HBC by allowing their detection at greater depth. They can count five times more fish than when using hoop nets. They will also integrate LCR antennae work into their models. At end of work plan, they will analyze the fish translocation data in the population model with rest of population model, and quantify the impact of translocation. They will continue to look at impacts of the environment on spawning probability. The Fish and Wildlife Service (FWS) leads monitoring on the LCR in the spring and fall. They are considering changing the fall trip by adding a second gear type and avoiding floods. This could reduce trips from two to one and improve cost effectiveness. Juvenile chub monitoring in the mainstem will continue, and will probably decrease from four to three trips. They will focus on the times of year during which they are most effective in capturing them: April, July, and October. That is starting this year; they are waiting to hear if they will be permitted. They also plan to slightly increase the spatial study to decrease trips. The current system of PIT tag arrays is degrading, and they want to pilot shore-based antennae, which could costs to 25% of the current expense and potentially have a smaller footprint on the LCR. They will continue sampling at the aggregation sites.

1. New research.
   1. Charles said that they are looking into establishing juvenile chub monitoring (JCM) in western Grand Canyon. They learned a lot at the LCR, and something is now happening in western Grand Canyon. They want to find the drivers. The BO said to find the drivers of the aggregations. The natal origins project did the first part of the trip, and JCM the rest. Now they propose to do JCM in first part, and then JCM in western Grand Canyon in the second half. These trips will be six to seven days each, and include Parashant and Pumpkin Springs, among other places, to determine which is best.
   2. Also they will do otolith microchemistry work in western Grand Canyon for incidental takes, which was recommended by the fisheries Protocol Evaluation Panel (PEP).
   3. David Ward said another new element is to use drift nets to measure larval HBC movement from the LCR and Havasu Creek, to determine how many exist in those creeks and the timing of the out-migrations. If the numbers of larval HBC vary highly from year to year, the next step is to evaluate the impacts of dam operations or of trout on abundance. Drift nets are commonly used to answer questions of quantity and timing.
   4. Another project will use thermal imaging to evaluate warm springs in the mainstem. They had a graduate student using ultrasound to look at eggs in HBC, and found that most females in the mainstem had ripe eggs. This was surprising given the water temperature, so they are postulating that those fish are finding warmer water somewhere. They want to use thermal imaging to find those warm springs. They used a handheld device and found some, and think they would be able to find more. They would work with a graduate student to map the thermal warm springs in conjunction with where HBC are found. In response to a question about why these springs were not found earlier, David said that they think they are subsurface, under the mainstem, and so easy to miss. Scott added that this is a new development. HBC females don’t release their eggs, so they didn’t know the status of their sexual maturity. They learned from this study that there are more ripe females in the mainstem then they knew.
   5. The final new element would be data mining to identify environmental conditions where ripe HBC are found, in order to link habitat to spawning grounds (which are currently unknown). They would look at existing data showing where when they are caught and analyze those data in a spatial framework. They would identify the spawning locations in the LCR and those habitat characteristics.
2. Translocations and research.
   1. David Ward said that continued translocations are called for above Chute Falls and the mainstem this year. This is led by Kirk Young at FWS. The fish are from the LCR, reared at Dexter, and going into the lower end of the mainstem in several locations this year. FWS is also conducting a feasibility analysis for translocation above Beaver Falls. This will require consultation with tribes and coordination with them, if possible.
   2. They are also proposing an investigation into imprinting in HBC. They have done translocations without understanding imprinting. Most of the other Colorado River fish imprint, but there is no information on imprinting for HBC. This would be laboratory work, linking spikes in thyroid hormone levels with olfactory imprinting. If that is what occurs, and fish are translocated, they won’t stay there; they will return to the LCR. Downlisting requires new aggregations, so there is a need to know what and when imprinting happens.

Shane asked for questions and discussion from attendees.

* How much work is done on predation before translocations?
  + Translocated fish are adults, so they will not be eaten except by large bass or catfish. So we think there is a low predation rate. This will be the first time that we have translocated to the mainstem.
* Will sonic tags be used this year or next year?
  + That will be this year in the current work plan. FWS has said we should translocate with sonic tags so the fish can be tracked. We are still working out the details for the next work plan. If it shows promise and is effective, it might make sense to continue sonic tags. We currently have a placeholder for that decision. The context is that the FWS BO calls for mainstem translocations if the tier 1 trigger is met; that is, if the fish fall below a certain abundance for subadults and adults. This could become a management action; it could be that we are to do some groundwork now to make sure it will be effective strategy.
* Please clarify: translocations this year are in western Grand Canyon and the conservation measures are to be near the LCR. If you are refining techniques, why are you doing that away from the LCR?
  + David Ward said that research needs to be done at the LCR. It is proposed to have translocations above Chute Falls, away from predators, and this needs to be evaluated, as well.
* Regarding Chute Falls, the conservation measures call for not only evaluating growth, but also measuring survival or contribution to adult populations. What are your thoughts for that?
  + It’s my hope that we will get at those things with this analysis. The evidence that growth is better above Chute Falls is convincing, and it could be that survival is similar. We need to see how many adult fish are adding to the population and compare rates in the LCR to above Chute Falls. We need to quantify the difference in survival and population.
* Another BO item is population modeling and estimates for mainstem fish in the mainstem aggregation. What are your plans for that?
  + Charles said that mainstem fish are in the estimate of the multistate model. We keep track of fish size and location; the tricky part is defining the “rest of the Colorado.” How far does it extend? If you include fish marked 100 miles downstream, that is problematic. We need to keep looking at that. We are already making abundance estimates for fish spawning in the LCR.
* The LCR population estimates are inclusive of LCR and mainstem aggregations.
  + Charles said they are inclusive of the adult population that spawns in the LCR. We think all fish in JCM spawn in LCR, plus we have fish in the LCR.
  + Scott said we have to look at the specific language. We have been struggling with this. In the previous BO, we had a lot of back and forth on this with FWS. They wanted a means of estimating abundance in the mainstem and the aggregations. We tried a couple of different ways. The report was rejected in peer review because the methodology was suspect. Some in FWS are interested in an inclusive estimate that includes the entire Colorado River ecosystem in Grand Canyon; but with the isolated populations of aggregations, this is challenging because of the small sizes. One concern is potential negative impacts on the aggregations because of the amount of handling. We’ll continue to work on it.
  + Charles added that JCM west and the portable antennae could potentially help us with this.
* Are we being prudent in doing translocations without knowing about imprinting?
  + David Ward said this was his argument. We need to understand imprinting before too many more management actions. We are overdue in answering this question.
  + Charles said one could argue that Chute Falls shows improved growth and survival, and whether they spawn there or not is not so important. At Havasu, there are no fish there anyway, so could be positive. But for the mainstem, we need to know.
  + Scott added that we have a little information. A handful of translocated fish have returned to the LCR. They are PIT tagged so we know some are moving back.
* Even though a small number have returned to the LCR, there are many more that have stayed in the reach where they were translocated and are contributing to that aggregation.
  + We know they stayed, but we don’t know if they are contributing to the population. Maybe they will stay, but if we understand imprinting, that will change how we translocate. Maybe we translocate pre-spawn adults so the larval fish imprint on the tributary.
* The fish in Shinumo Creek that never matured: was that due to imprinting?
  + There is a lot we don’t understand. Even salmonids can stray to a different stream; it is all part of the population dynamics. We just need to answer the questions about imprinting.
  + Scott added that the example of Shinumo had unfortunate timing because of the fire and flood. We are guessing, but we think they were just getting to where they might have matured and started actively spawning.
* Will doing JCM in western Grand Canyon be cost effective? What will it get us?
  + In the past, we did a second trip, but the return was minimal when you look at the amount of effort: two or three nights of hoop netting. With JCM, we use multiple gear: we do electrofishing, we are on shore. There is an art to doing this. We need the right boatman and Mike Yard to get them into nearshore environment. We are also incorporating seining in Grand Canyon west. JCM west may not work; I wonder how much of the resurgence is one big year class vs. a number of year classes. We will learn more with the pilots.
  + Ted Kennedy added that this intrigued him. In the foodbase work, we see chub growth with higher water temperatures, even though the foodbase is poorer than the LCR. Estimates of growth rates from downstream will resolve some questions about temperatures and foodbase.
  + Scott added this was different from what has been done in the past: marking small fish. JCM has been so successful that we want to try it in another location and use it to better understand what is going on in western Grand Canyon. One of the most interesting developments in recent years is the expansion of chub there.
* Is the translocation of adults into western Grand Canyon starting next year?
  + That is in the current work plan for 2017. FWS is leading the project with help from GCMRC. In new work plan, FWS may do some follow up in the mainstem, contingent on how things go this year.

## Foodbase

Ted Kennedy said the foodbase proposal was divided into three categories.

1. Continuation of existing foodbase monitoring programs.

The long-term drift monitoring in Lees Ferry has been ongoing for 10 years. The proposal is to continue the citizen-science light trapping, which is in its sixth year; and the sticky traps in Glen Canyon, which is in its fourth year. These provide important baseline data on the status of the foodbase and evaluate how the foodbase is responding to changes in management or in water temperatures.

1. Foodbase monitoring and support of HBC and invasive species range expansions.
   1. They are proposing to do some foodbase monitoring and monitoring drift wherever the JCM West happens and at the existing JCM monitoring site near the LCR confluence. They propose to compare and contrast foodbase conditions at these two locations, along with growth rates and temperatures, to better understand what role food plays in expansions of HBC populations in downstream sites.
   2. They are also proposing some new small-scale drift and emergent foodbase work downstream of Diamond Creek, where little is known about foodbase and where HBC and RZB are growing.
   3. Finally, they propose to continue foodbase monitoring in the LCR in collaboration with the FWS, and initiate new foodbase research in tributaries like Bright Angle Creek and Shinumo Creek, among others. They will describe foodbase conditions and study invertebrates to understand how mayflies and caddisflies colonize in the mainstem. Also, they are trying to understand if changes in foodbase in Lees Ferry are contributing to the increase in the BNT population. They think BNT prefer mudsnails and gammarus. They are also tracking quagga mussels from the Glen Canyon Dam to Grand Canyon, by putting down artificial substrates in the spring and retrieving them in the fall. This is commonly used to monitor quaggas: they let them incubate and then compare growth rates and population densities as a function of distance downstream.
2. New monitoring and research in anticipation of new flow experiments proposed in the LTEMP.

The experiments are macroinvertebrate flows (bug flows), trout management flows (TMF), and changes in HFE timing. If bug flows are tested, they will do targeted monitoring and research at different locations in Grand Canyon, proximate to tributaries, that might support EPT taxa that might colonize the mainstem. Also, they will attempt to determine whether habitat substrate quality is affecting foodbase production, and perhaps serving as a constraint on EPT. The idea here is that if cobble bars are clogged with algae invasives, they may not be suitable for aquatic insects to colonize. So they plan to test mechanically scrubbing rocks to see how habitat quality affects foodbase production. They evaluate macrophytes (aquatic plants) and see how they affect the quality of benthic substrates and what kind of invertebrates they support. They also plan research in the tailwaters of Colorado River basin, at Parker, Davis, and Hoover Dam. Despite big daily changes in discharge (load following) at these dams, there are caddisflies there, contradicting the findings of GCMRC’s paper that posited that daily fluctuations are bad for EPT species. This will build on one year of investigation funded by Western Area Power Administration two years ago.

Shane asked for questions and discussion.

* How much of the information below Parker and Davis could you get from the Multi-Species Conservation Project (MSCP)? Do you need to actually go there, or is there information available?
  + Ted: I don’t think anyone is studying these insects. I have heard a rumor that MSCP might hire an entomologist. We have also tried to get funding from MSCP for this work but they are on a three-year funding cycle and I don’t know if they will fund us for a year or two.
* MSCP is on an annual funding cycle. Have you looked at the work on flannelmouth sucker below Davis?
  + Ted: I am not familiar with that. We want to look at the caddisfly populations.
* Lots of work has been done down there on foodbase and native fish.
  + Ted: We will look into that.
* Is any work done on EPT in Flaming Gorge?
  + Ted: Maybe, but the habitat is closer to Grand Canyon when you go downstream than when you go upstream.
* Water temperatures are colder upstream and warmer downstream.
  + Ted: We have natural-looking temperatures in Colorado River downstream. We don’t see caddisflies, so we think it is the load following. That is why we find that downstream situation so interesting.
* What methods will you use to monitor the effects of flow experiments and bug flows?
  + Ted: We have very valuable long-term monitoring in place like the 10-year record of drift at Lees Ferry and six years of adult insect citizen science. If we knew what flow experiments were coming, then we could develop the details. We have a consensus here about the logical sequence of flow experiments. We are open to engage here and with Reclamation and others to see if we can come to consensus on what should be tested in the next three years.
* How planning to evaluate bug flows: light trapping, drift netting?
  + Ted: All those metrics will be used to track ecosystem response to bug flows: invertebrate drift, light trapping, sticky trapping. We also propose some continuation of the egg laying work we started. We think bug flows will lead to higher survival of eggs. So we want to do more research on eggs around tributaries with EPT populations. In terms of analysis, and before and after comparisons: we have the record of drift from Lees Ferry. If bug flows benefit some type of insect, we should see an increase of drift in those species. We also have a five-year record of light traps that is spatially intensive. We should see a higher catch rate for midges and others.
* According to the LTEMP ROD, we can do bug flows in 2018, right?
  + Katrina: That is correct.
* Do we also have the potential for a TMF?
  + Katrina: Yes, pending the projected trout numbers, which is tied to hydrology.
* When should we start those discussions of 2018 experiments—at the TWG meeting in April?
  + Katrina: That is a great question. We also need to talk about fall HFE. Maybe at the TWG meeting, may not be prepared, or spring early summer.
* Are you proposing any work with emergent substrates and the effect on invertebrates’ biomass? That is, looking at rocks and natural substrates, or experiments with unnatural substrates.
  + Ted: We just did some pilots on egg laying last summer, and the results were intriguing. We are planning to do more studies this spring or summer during the egg-laying season. It is hard to say where they will go. We’ve seen in Lees Ferry that emergent substrates are important. We put black pipes along different shoreline types and millions of eggs were laid on them. This was near large emergent rocks. On a microscopic level, the natural substrates were clogged with algae and muck and it was harder to see the eggs.
* It is important to keep looking at this.
  + Ted: Right, we are interested to see how bug flows works. If it pressure washes the cobble bar, simulating a big flood, what kind of bugs will we see on different quality substrates? We are thinking of experiments beyond flows.
* Would the mesocosm experiments be at the dam or at Lees Ferry?
  + We have different options, and we want to talk with Reclamation about them.
  + We’ve also discussed partnering with high school science classes in Page when we use artificial streams for experiments. The kids could help maintain the experiment, and this could lead to summer internships. In this case, having it at the dam would make sense.
* It appears there is a loss of foodbase with fall HFEs. Are you trying to figure out if this is occurring?
  + We can switch the timing of HFEs or turn them off, not running them for a sequence of years. We know what will happen to sandbars if you don’t run HFEs. If you want sandbars, then test spring HFEs. We saw positive foodbase response to the 2008 spring HFE.
* We’ve had some years with fall HFEs and some years without. What type of information do you have to separate out the effects?
  + In the foodbase KA, we say fall floods have a neutral to negative affect on foodbase. Given enough time without disturbance, the foodbase will become dominated by mudsnails. When there was a four-year gap since the last HFE, the system was overrun with mudsnails. It was a degraded foodbase. So it is hard to see if fall HFEs have made it any worse. But if you compare the foodbase response to the 2008 HFE, the highest midge and blackfly abundance are from 2008. Next highest is 2009. There were enormous increases of 500%. Spring HFEs seem to be very positive.
* There is a short-term impact on foodbase, month to month, after a fall HFE. Have you looked at a finer timescale yet?
  + No. This could tell us if fall floods are neutral or negative on foodbase. We need to run the foodbase numbers through the bioenergetic model, but it is more complicated than that. If you want to manage for insects, emergent life stage for birds and bats, then do spring HFES. If you want mudsnails, fall floods are good way to get them.

Shane noted the next call would include presentations on cultural resources, socioeconomics, sediment, and Reclamation projects. The meeting adjourned.

1. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). [↑](#footnote-ref-1)