Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 24-25, 2016

Agenda Item

2016 Annual Reporting Meeting Update

Action Requested

Information item only; we will answer questions but no action is requested.

Presenters

Scott VanderKooi, Chief, Grand Canyon Monitoring and Research Center
Paul Grams, Research Hydrologist, Grand Canyon Monitoring and Research Center

Previous Action Taken

N/A

Relevant Science

N/A

Summary of Presentation and Background Information

The January 2016 Annual Reporting meeting was held January 27-28, 2016 in Phoenix, Arizona followed by a one-day Technical Work Group meeting. The two-day meeting included presentations by Grand Canyon Monitoring and Research Center (GCMRC) staff, cooperators and collaborators, staff of sister federal agencies, and Tribal representatives. Speakers presented summaries of findings from work conducted as part of the FY2015-17 Glen Canyon Dam Adaptive Management Program budget and workplan and discussed insights of management significance.

Each of the three high-flow experiments implemented under the high-flow protocol since July 2012 resulted in **sandbar deposition** in Marble and Grand Canyons. Although sandbars have also eroded following each high-flow, the long-term monitoring sites were, on average, larger 10 months following each of the high flows than at any other time between 2009 and 2012. Because Paria River sand inputs have been relatively large and annual release volumes from Lake Powell relatively low, there has been maintenance or accumulation of sand since July 2012 in Marble Canyon and in Grand Canyon downstream from river mile 87. The segment of Grand Canyon between river mile 61 and river mile 87 has experienced net sand evacuation over this same period. We will report on progress made on research studies of sand bedload transport and interactions between vegetation establishment on sandbars and sandbar response to high flows.

FY2015 was the first year of a new project focused on developing **long-term monitoring protocols for cultural sites** and evaluating effects of aeolian sediment transport and other geomorphic processes on long-term archaeological site condition. Only a few days of field work

occurred in FY2015, as our main focus was on analyzing existing data and developing a new monitoring plan. Several iterations/drafts of the new plan for monitoring geomorphic change at archaeological sites prepared in consultation with the Bureau of Reclamation, National Park Service and the Tribes underwent extensive review and revision. GCMRC staff is proceeding with the plan for initial monitoring work and data collection during FY2016 and 2017. The monitoring plan will be re-evaluated by GCMRC and all stakeholders during 2017 when the current Triennial Work Plan is complete and the next work plan is drafted.

In FY2015 GCMRC staff worked with US Geological Survey colleagues Brian Collins and Skye Corbett to prepare for implementing the new monitoring plan and to transfer knowledge and obtain training with GCMRC's new lidar equipment and data processing software, as well as to develop long-term data storage and management protocols. The field training was performed at three sites in Glen Canyon in March 2015, and the resulting data were subsequently analyzed in relation to previous terrestrial lidar surveys and Digital Surface Models developed for Glen and Grand canyons in 2002 and 2009. These results will be incorporated into the first report of the new monitoring plan during FY2017. In addition to working on the new monitoring plan, the Project 4 team undertook Geographic Information System analyses to investigate how landscape characteristics of the terrain located between minimum and maximum river flow elevations influence the distribution and area of aeolian sand above the maximum flow elevation. The goals of these analyses are to identify statistical relations that can be used to: 1) model fluvially-sourced aeolian sand above the maximum regulated flow elevation using remotely sensed data; 2) identify potential characteristics related to fluvially-sourced sand that can be applied to future mitigation efforts; and 3) refine the conceptual understanding of connectivity between the modern active channel and the surrounding river corridor.

Summary **monitoring data for riparian vegetation** at random sites within river segments (surveyed in 2014), including Glen Canyon (surveyed in 2015), indicate that total foliar cover differs among segments (lowest between the Little Colorado River and Kanab Creek in the Eastern Grand Canyon segment). Among geomorphic features, foliar cover was greatest on channel margins. Woody vegetation cover is fairly constant across river segments. In Marble Canyon, cover of woody species on sandbars is notably higher than in the other river segments. Tracking of nonnative species cover identifies great cover in Western Grand Canyon. Tamarix sp. (tamarisk) is particularly frequent on channel margins in Marble Canyon, leading to high nonnative cover values for this segment. Sampled vegetation and complementary response guilds are being used in a retrospective analysis of sandbars to understand the control of sediment dynamics by vegetation and biogeomorphic succession. Preliminary analysis of plant community associations suggests the river corridor's plant assemblage changes with distance from the dam. The different community assemblages may respond differently to hydrology and may also have a different effect on sediment dynamics and sandbar response. As discussed in a restoration workshop convened in June 2015, both monitoring data and research that utilizes guilds can be used in the consideration of restoration priorities and approaches.

Aquatic insects are the primary prey for all species of native fish in Grand Canyon including humpback chub. Aquatic insects are also a key prey item consumed by rainbow trout in the Lees Ferry sport fishery. In FY2015, Project 5 continued to evaluate potential causes of low aquatic insect abundance and diversity in Glen, Marble, and Grand canyons. Collaborator Scott Miller at

Utah State University investigated the effect that brief desiccation had on survival of aquatic insect eggs. These experiments clearly demonstrate that brief exposure to air renders aquatic insect egg unviable. Specifically, egg hatching rates were less than 1% for all desiccation treatments of one hour or longer, whereas experimental controls (i.e., no desiccation) had egg hatching rates that exceeded 50%. Building on these experimental results, collaborator David Lytle of Oregon State University developed a life history-hydrodynamic model to determine how different types of egg-laying behaviors (e.g., open water vs. river edge) will influence the response of aquatic insect populations along a load-following river continuum. This model predicts that ecologically important insect species such as mayflies will be extirpated from rivers below load-following dams. These species have a basic life history trait of egg laying along shorelines predicated on river edge habitats that are eliminated by load-following. The model also predicts that even insect species with more generalized egg-laying behaviors such as midges will be depressed by load-following, exhibiting spatial periodicity in abundance related to the daily timing of load-following waves. Specifically, the model predicts abundance of midges should be greatest in reaches where the timing of daily minimum flows is in phase with the dusk timing of peak aquatic insect egg laying. Eggs laid in these locations will remain wetted throughout the day and will never be desiccated. These model predictions are supported by datasets compiled by GCMRC researchers including a >2500 sample citizen science dataset of aquatic insect abundance throughout Grand Canyon and comparison of aquatic insect diversity and load-following intensity across dammed rivers of the Western US. Thus, investigations by the Project 5 team demonstrate a life history bottleneck for aquatic insects arising from load-following operations that constrains their abundance and diversity downstream of load-following dams. These results have implications for the conservation and management of the native and desired nonnative fish populations in Glen, Marble, and Grand canyons that rely on aquatic insects as prey.

Annual estimates of spring **abundance of humpback chub** in the Little Colorado River for fish >150 mm and >200 mm declined noticeably in 2015. It is unclear if these declines are because of an actual decline in adult chub population abundances or due to reduced number of adults choosing to spawn because of poor body conditions among adult chub beginning in September 2014. Juvenile humpback chub survival estimates in the mainstem Colorado River near the Little Colorado River confluence for the interval from July 2014 to July 2015 were similar to those observed for the July 2013 to July 2014 interval. There is some, still fairly weak, evidence of increasing juvenile chub survival in the last half year as trout numbers have decreased. The trend in declining abundance of rainbow trout between Glen Canyon Dam and Lees Ferry stabilized in 2015 to levels of approximately 200,000 fish. Unlike in recent years (2012-2014), the relative condition of rainbow trout has increased. In contrast to observations made last year, abundance estimates for rainbow trout near the Little Colorado River confluence have decreased below trigger levels identified in the 2011 Biological Opinion for Nonnative Fish Control. No action is warranted at this time since other triggering criteria have not been met.