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Science Activities Associated with Proposed 2008 High-Flow Experiment at Glen Canyon Dam

Grand Canyon National Park lies approximately 15 miles downriver from Glen Canyon Dam, which was built on the Colorado River just south of the Arizona-Utah border. Because the dam stops most sediment moving downstream, its presence has resulted in erosion and shrinkage of river sandbars in Grand Canyon. Fewer and smaller sandbars mean smaller camping beaches for visitors to use, continued erosion of cultural sites, and possibly less habitat for native fish, including the endangered humpback chub.

In an effort to restore sandbars and related habitat and to comply with its responsibilities under the Grand Canyon Protection Act, the Department of the Interior has proposed a high-flow release of water from Glen Canyon Dam in March 2008. The U.S. Geological Survey's (USGS) Grand Canyon Monitoring and Research Center is responsible for coordinating research associated with the proposed experiment. The proposed studies are designed to evaluate the feasibility of using such high flows to improve a range of Grand Canyon resources.

A sandbar along the left shore of the Colorado River near river mile 30 shortly before (top) and shortly after (bottom) the November 2004 high-flow experiment. People and boats indicate scale.

Background

Before Glen Canyon Dam was built, spring snowmelt swelled the Colorado River, contributing to the river's natural flood cycle and transporting large quantities of sand that created and maintained Grand Canyon sandbars. Now most of the river's sediment is trapped behind the dam. The 2008 high-flow experiment is designed to simulate, to some degree, the natural sand-carrying activity of the pre-dam Colorado River by moving sand that has entered the system from tributaries below the dam up and onto sandbars.

Two similar tests were conducted in 1996 and 2004. In the 1996 event, scientists learned that tributary-supplied sand does not accumulate on the riverbed over multiyear periods under typical dam operations. In fact, the 1996 high flow actually resulted in a net reduction in overall sandbar size. This finding led to the second high-flow test in 2004, when relatively large quantities of new sand had entered the system from tributaries below the dam.

The 2004 experiment resulted in an increase of total sandbar area and volume in the upper half of Marble Canyon (see photos), but farther downstream, where sand was less abundant, sandbars eroded. Scientists concluded that more sand than was available during the 2004 high flow will be required to achieve increases in total sandbar area and volume throughout all of Marble and Grand Canyons. The proposed 2008 experiment and accompanying studies will build upon the lessons learned from these two previous tests.

The Proposed 2008 High-Flow Experiment and Associated Research

The proposed 2008 experiment will be different from the two previous tests in several important ways. In November 2007, sand supplies in the main channel of the Colorado River were approximately three times larger than in 2004, a result of flooding on the Paria River, which enters the Colorado just downstream from Glen Canyon Dam. Such an abundance of sand occurs, on average, only once a decade. A second important difference is that the high flow will be followed by normal dam operations. This experiment will thus help determine if new sand deposits can be retained under normal operations.

Research associated with the 2008 experiment (listed in the table) will focus on a wide range of questions, not just whether high-flow releases are capable of rebuilding and maintaining sandbars over time. Do such releases have the ability

Experimental studies associated with the proposed 2008 high-flow experiment.

Experimental study	Description
1.A. Sand budgeting	Data will be collected to determine the amount of sediment available in the system and its availability for restoring sandbars and camping beaches, patterns of erosion and deposition, and changes in sediment grain size.
1B. Eddy-sandbar studies	Data will be collected on the evolution of specific eddy sandbars before, during, and after a high flow. These data will be used to improve the predictive capabilities of the existing sediment model and determine the optimal peak flows of future high-flow experiments.
1.C. Response of sandbars and select cultural sites	Data will be collected to determine whether (1) sandbars throughout the Colorado River ecosystem gain or lose sand as the result of a sand-enriched high flow, (2) new sand can offset gully erosion, and (3) enlarged sandbars provide source material for the windborne transport of sand upslope into archaeological sites.
1.D. Backwater habitats	Measure backwater habitats and sample them for fish in spring and fall to evaluate (1) how backwaters formed by a high flow change over time and (2) how fish, particularly humpback chub, use backwaters.
2. Riparian vegetation studies	Document changes in riparian vegetation following a high flow to determine if disturbances influence the success of nonnative species.
3. Food availability	Data will be collected to determine how high-flow experiments affect the quantity and quality of food available to invertebrates and, ultimately, fish.
4.A. Redds (fish-nest) study	Data will be collected to determine how high-flow experiments affect spawning and survival of early-life stages of rainbow trout in Lees Ferry.
4.B. Movement study	Data will be collected to determine if high-flow experiments displace rainbow trout from Lees Ferry and if displacement varies by fish length.
5. Lake Powell	Data will be collected to determine if a high flow results in higher nutrient releases and changes in the reservoir's hypolimnion.
6. Kanab ambersnail	Kanab ambersnail habitat at Vaseys Paradise will be moved to minimize impacts to an endangered species.
7. Synthesis of knowledge	Data and knowledge gained as the result of the high-flows test will be synthesized in an attempt to address strategic science questions required to improve management.

to create advantages for native fish? Is it possible that high flows can temporarily displace nonnative fishes? Can they build and maintain backwater habitats that possibly offer growth advantages to humpback chub and other native fishes? Can new sand deposits help protect cultural sites? Will increased sand carried by the wind from restored sandbars reduce erosion and increase the preservation potential at archaeological sites? What effects do high-flow experiments have on riverside vegetation, on rainbow trout, on the aquatic food base that supports native and nonnative fishes, and on Lake Powell water quality?

A comprehensive synthesis of the results of all of the experimental studies conducted in association with a possible 2008 experiment and previous high-flow tests is planned. Additionally, the data gathered in the proposed 2008 experiment will inform the continued development of a sediment transport model for the Colorado River. The improved model will help determine the optimum frequency, timing, duration, and magnitude of future high-flow releases.

Collaboration

The 2008 high-flow experiment and associated research activities will be undertaken cooperatively by scientists and resource managers from the Department of the Interior's Bureau of Reclamation (Reclamation), National Park Service, U.S. Fish and Wildlife Service (USFWS), and U.S. Geological Survey (USGS). State and university partners will also provide assistance.

Reclamation operates the Glen Canyon Dam and will conduct the release. In compliance with the Endangered Species Act (ESA), Reclamation has prepared a biological assessment that evaluates the impact of the proposed experimental operations on listed species. In response, the USFWS is preparing a biological opinion that will provide ESA compliance for both the 2008 experiment and other experimental flow operations from the dam for the next 5 years. Reclamation has prepared an environmental assessment, which is is available to the public for comment.

The National Park Service is working with other agency partners to carry out an outreach plan for the public, especially river runners and backcountry users, about safety concerns during the proposed high flows. A decision by the Department of the Interior on performing the high-flow experiment is anticipated in late February 2008, with plans to conduct the test in early March 2008.

The science activities associated with the proposed experiment were developed with the guidance of the Glen Canyon Dam Adaptive Management Program, a Federal initiative designed to assist the Secretary of the Interior in protecting resources downstream of Glen Canyon Dam. The program includes a wide range of stakeholders, including Native American tribes, Colorado River Basin States, environmental and recreation groups, power customers, and State and Federal agencies.

The most current and additional information about the proposed high-flow experiment may be found by visiting www.gcmrc.gov.

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