GCDAMP Goal 12: Maintain a high-quality monitoring, research, and adaptive management program

AMWG Requested Project - Low steady summer flows – data and research compilation, synopsis and synthesis

Start Date
January 2008

End Date
September 2010 (conducted in phases with specific end dates)

Principal Investigator(s)
Barbara Ralston, lead coordinator, cooperators involved in Low Steady Summer Flows (LSSF) data collection, GCMRC's Data Acquisition Storage and Analysis Group.

Geographic Scope
Entire Colorado River ecosystem corridor from forebay of Glen Canyon Dam to upper Lake Mead

Project Goals/Tasks
The overall goal of this project is to develop a synthesis of the effects of the 2000 LSSF Experiment on the Colorado River ecosystem. The tasks involved in reaching the final goal can be broken into three phases:

- **Phase I. – Status of reports/data and synopsis** - Identify data and products associated with the 2000 LSSF experiment; synopsize the results of the individual projects;
- **Phase II. Data evaluation and identification of secondary analyses -** Evaluate individual datasets and provide recommendations for further analysis resulting in integration of resource responses to operations;
- **Phase III. Synthesis -** Use integrated analysis results to develop a synthesis of the effects of the 2000 LSSF Experiment on the Colorado River ecosystem.
- **Phase IV. Publication –** Publication of secondary analysis is special volume of journal or USGS circular or other publishing source.

The project outcome is intended to provide managers, and others interested in resource management, with information about how multiple resources respond to a series of flows that varied in duration from several days to several months and in magnitude from 8k cfs to 31k cfs.

Need for Project

The Adaptive Management Working Group (AMWG) identified in August 2007 that there was a need to produce a summary document of the effects of the LSSF Experiment (implemented in spring and summer 2000) on resources. The managers requested this summary project so that

the results could be used by managers as they implement long-term experiments associated with the Glen Canyon Dam EIS currently under development by the Bureau of Reclamation.

The data collected in association with the 2000 experiment were in the areas of sediment transport and storage, mainstem and shoreline temperature, small-bodied fish sampling, long-term monitoring methods development for mainstem fishes, vegetation change, and recreational aspects of the varied flows. To date several of the data collection efforts have resulted in data reports or journal publications, while others projects remain incomplete, lacking a final report. The lack of a unifying document regarding the flow experiment may be perceived as an impediment to learning and applying this knowledge in an adaptive management setting. It is for this reason that a summary document is being proposed that synopsizes individual resource response and considers collective resource responses within an ecosystem framework.

Strategic Science Questions

Hypothetically, the Low Steady Summer Flow Experiment affected multiple resources and similarly, there are multiple Strategic Science Questions (SSQs) that pertain to the flow experiment. The summary project will investigate whether and to what degree these SSQs were addressed by the 2000 LSSF experiment. Those SSQs most pertinent to the LSSF experiment are listed below.

SSQ 4-1. Is there a "Flow-Only" operation (i.e. a strategy for dam releases, including managing tributary inputs with BHBFs, without sediment augmentation) that will restore and maintain sandbar habitats over decadal time scales?

SSQ 5-1. How do dam release temperatures, flows (average and fluctuating component), meteorology, canyon orientation and geometry, and reach morphology interact to determine mainstem and nearshore water temperatures throughout the CRE?

SSQ 4-2. How important are backwaters and vegetated shoreline habitats to the overall growth and survival of YoY and juvenile native fish? Does the long-term benefit of increasing these habitats outweigh short-term potential costs (displacement and possibly mortality of young humpback chub) associated with high flows?

SSQ 1-7. Which tributary and mainstem habitats are most important to native fishes and how can these habitats best be made useable and maintained?

SSQ 2-1. Do dam controlled flows affect (increase or decrease) rates of erosion and vegetation growth at archaeological sites and TCP sites, and if so, how?

SSQ 3-9. How do varying flows positively or negatively affect campsite attributes that are important to visitor experience?

Links/Relationships to Other Projects

Because much of the biological data collected in 2000, in association with the LSSF, represent a single growing season or single cohort, data from subsequent years could be used to understand the effects of a single year on recruitment signals or species compositions in subsequent surveys.

These LSSF data would be linked to monitoring data from fisheries and vegetation collected since 2000, including the using retrospective analysis of imagery to assess change through time. The sediment response throughout the duration of the project can be incorporated into the current shoreline study project to understand the relationship of reworking eddy sand supply and available shoreline habitats through remote sensing analysis. In the same vein, water temperature data collected in 2000 is applicable to current water temperature modeling efforts for shoreline habitats. Lastly, recreational aspects associated with downstream travel and visitation could be interpreted under the current Colorado River Management Plan to determine how similar flows, if they occur in the future, might affect recreational experiences.

Information Needs Addressed

Information needs that pertain to work done during the LSSF are focused on Experimental Information Needs for each resource. Specific Information Needs that focus on adaptive management and that are pertinent to the proposed project are:

IN 12.1. Develop information that can be used by the TWG, in collaboration with GCMRC, to establish current and target levels for all resources within the GCDAMP as called for in the GCDAMP strategic plan.

RIN 12.3.1. As necessary, investigate the most effective methods to integrate and synthesize resource data.

General Methods

As a part of the 1994 biological opinion associated with the operations of Glen Canyon Dam, the Fish and Wildlife Service provided reasonable and prudent alternatives (RPAs). One element of the RPAs directed the Bureau of Reclamation to initiate a program of experimental dam releases consisting of high steady spring flows and low steady summer flows. The intention of these experimental releases was to reduce the risk of further jeopardizing endangered native fishes.

A plan of flows was developed by SWCA Environmental Consultants, Inc. (SWCA, 2000). The plan divides the flows into three time periods: March-May (high flows of 21k cfs with a 31k cfs spike), June- September (steady flows of 8k cfs, ending with a 31k cfs spike), and October-February (8k cfs flows). The flows that were implemented in spring of 2000 were slightly different in that the high flows in the spring were slightly lower discharge of 17,500 rather than 21,000, and the duration of the flows was shorter by approximately a month (Fig 1).

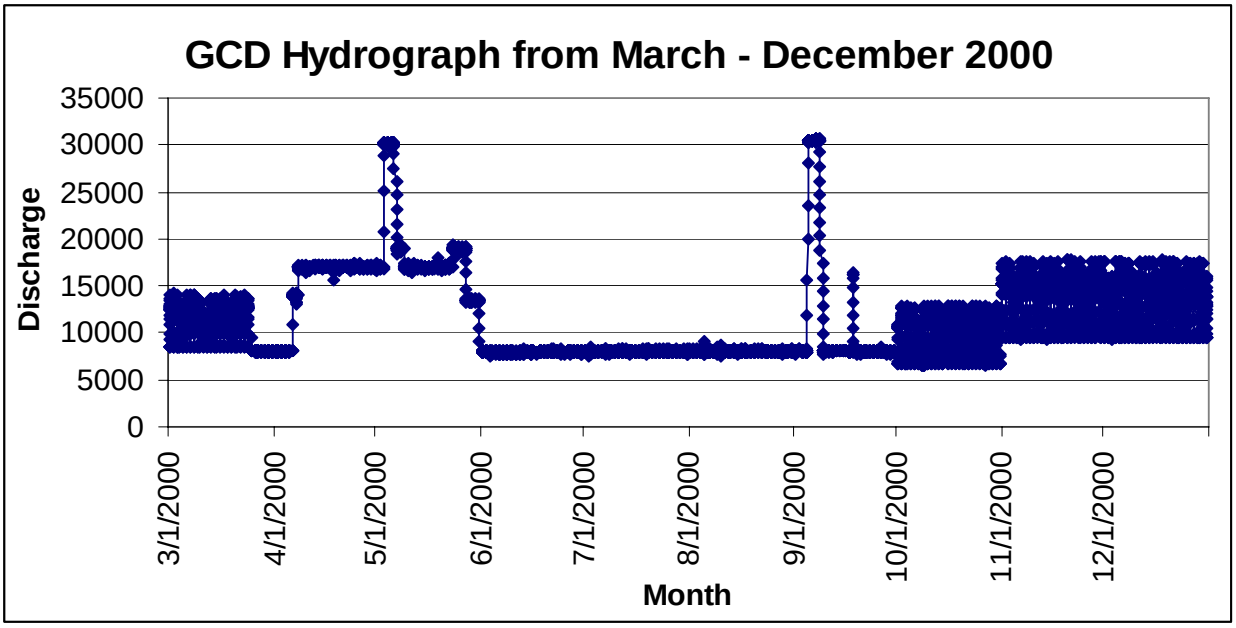

Figure 1. Hydrograph from March – December 2000 including discharge pattern associated with Low Steady Summer Flow Experiment

Data collected around these flows focused on physical resources (sediment, water temperature), biological resources (aquatic productivity, fisheries, vegetation), and cultural resources (recreation, economics). SWCA (2000) provided some hypotheses regarding the benefits and risks to abiotic and biotic resources relative to each flow period (Table 1). It is proposed that these hypotheses form the basis for data consolidation, synopsis, secondary analysis and subsequent synthesis.

Table 1. Hypothesized effects of flows on physical and biological resources

Benefits/risks to Resources	**Period I: March-May**	**Period II: June-September**	**Period III: October - February**
Benefit to Physical resources/habitat	-scour backwaters -May spike flow mobilize and store sands and sediment	-store sand and sediment in river channel -expand campable beach area -September spike flow resuspend and store sand from summer tributary inputs	
Risks to physical resources/habitat	-export sediment, reduce campsite areas	-September spike export sand and sediment instead of storing it.	- no significant risks
Benefits to biotic resources	-ponded tributary inflows as thermal refuges for drifting larvae and young fish -ponded tributary inflows ease access for spawning native fishes -destabilize habitats to disadvantage non-natives	-increased growth and survival of young native fishes -increase autotrophic algal and macroinvertebrate production -possible mainstem hatching success -spike flows flush non-	-increased survival of young native fishes -maintain stable winter conditions to minimize energy expenditure -maintain overwinter autotrophic production in mainstem, shorelines, backwaters.

	-Redistribute nutrients -Reset community production -Spike flows flush nonnative fish from nearshore habitats	natives fish from nearshore habitats	
Risk to biotic resources	-warm ponded tributaries attract nonnative fish predators/competitors	-mainstem reproduction by nonnative fishes -increased growth and survival of nonnative fishes -increased infestation of parasites and diseases -decreased drift of food for fish -minimize thermal plume at 30-mile may reduce survival of young HBC -increased water clarity leading to increased predation of native fish by sight predators	-possible overwinter survival and expansion of nonnative fishes -possible greater spawning success of downstream populations of trout -increased predation by sight feeders -decreased drift of food for fish.

Approach: The consolidation, synopsis and subsequent synthesis of data from the 2000 steady flows experiment will be approached in phases with each phase resulting in a stand alone product.

Phase I. – Status of reports/data and synopsis (6 months)

- Identification of plan of studies – There were 25 studies identified in the LSSF plan as well as several overflights conducted throughout the period of March through September. Determine/describe the scope of each study and how many of the proposed studies were executed.
- Determination of location of data and other deliverables – call P.I.'s to determine status of project, location of data, identification of any work that was not done and/or cannot be done and consolidating data.
- Synopsize project results and describe the status of data (metadata report).

Phase II. Data evaluation and identification of secondary analyses (6 months)

- Evaluation of data compatibility in collaboration with DASA and resource specialists within GCMRC
- Identification of potential secondary analyses of data including incorporation more recent data to provide a longer term analysis of effects. Utilize proposed senior scientist to help identify potential and critical secondary analyses.
- Identification of P.I.'s available for secondary analysis and collaboration determination of funding needs and timelines.
- Development of statements of work for subsequent secondary analysis.

Phase III. Synthesis (15 months)

- Execution of secondary analyses incorporating more recent monitoring data and identification of publishing venue for research (e.g., special issue in Ecological Applications, American Geophysical Union?). Collaborators identified in Phase II.
- Incorporation of results into conceptual modeling exercise (e.g., Ecosim/ecopath) for ecosystem response analysis. Utilize talents of proposed senior scientist.
- Writing of results and discussion of secondary analyses and conceptual modeling effort
- In coordination with editing staff at GCMRC/SBSC, set-up review and complete draft manuscripts

Phase IV. Publication (3 months)

- In coordination with editing staff at GCMRC/SBSC complete publication of manuscripts in target journal or circular.

Products/Reports

- **Phase I.** Open file report providing background information about LSSF, synopses of individual project, metadata, background information about LSSF. Draft submitted by May 2008; Finalized by July 2008.
- **Phase II.** Work plans for secondary analysis and data report of data compatibility. Statements of work established for secondary analysis. Draft report submitted by October 2008; Finalized by December 2008.
- **Phase III.** Initiation of secondary analysis and collation of finalized manuscripts reviewed and ready for submission to target journal or circular for publication. Submitted by March 2009.
- **Phase IV.** Completed publication of manuscripts. Completed July 2010.