

Temperature Control Device Workshop  
January 22-24, 2001  
Saguaro Lake Ranch  
Mesa, Arizona

PRELIMINARY SUMMARY OF FINDINGS

Compiled by Dennis Kubly

**PURPOSE:**

The purpose of this workshop was to evaluate ongoing research and monitoring being conducted on the Colorado River Ecosystem (CRE), as defined by the Glen Canyon Dam Adaptive Management Program (GCDAMP), and to determine what modifications or additions should be made to the existing efforts to evaluate the effects of a temperature control device (TCD) on the dam, should the decision be made to construct and operate the device. Recommendations from the workshop would be used by the Grand Canyon Monitoring and Research Center, the Bureau of Reclamation, and other members of the GCDAMP in formulating and carrying out the scientific investigations charged with assessing the environmental effects of a temperature control device. Participants included individuals who are currently conducting, or have in the past conducted, research and monitoring efforts in the CRE, individuals who have conducted research and monitoring on other river systems in western United States, including regulated systems having dams with TCDs, individuals who have served on peer review panels that have evaluated research and monitoring efforts in the CRE, and resource managers engaged in management of resources within the CRE. The findings contained in this summary should be considered draft findings, because they have not been reviewed and commented on by the participants.

**REPRESENTED:**

- Grand Canyon Monitoring and Research Center
- Fish and Wildlife Service
- Bureau of Reclamation
- Environmental Protection Agency
- National Park Service
- U.S. Geological Survey
- Arizona Game and Fish Department
- Utah Department of Natural Resources
- Utah State University
- Arizona State University
- Colorado State University
- Northern Arizona University
- Argonne National Laboratory
- SWCA, Inc.
- Ecometrics Research
- Reservoir Environmental Management
- Stevens Ecological Consulting

**PRESENTATIONS:**

The workshop began with presentations on background information, modeling, and field research and monitoring. Speakers were asked to provide, where appropriate to their subject, the following information:

- Summary of variables being measured,
- Frequency and intensity of measurements,
- Methods of analysis,
- Ability to detect change in those variables,
- Recommendations for changes or additions to assess effects of a TCD.

#### OVERVIEWS

Dennis Kubly, Bureau of Reclamation, Salt Lake City, Utah and Barry Gold, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. The Glen Canyon Dam Adaptive Management Program: an effort to understand and manage the Colorado River Ecosystem in Glen and Grand canyons.

Barbara Ralston, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Overview of Long-term Monitoring of Biological Resources Along the Colorado River.

#### MODELING

Amy Cutler, Bureau of Reclamation, Salt Lake City, Utah. Predicted temperatures from Glen Canyon Dam temperature control device alternatives using CE-QUAL-W2.

David Harpman, Bureau of Reclamation, Denver, Colorado. The effect of a temperature control device on hydropower at Glen Canyon Dam.

Josh Korman, Ecometrics Research and Carl Walters, University of British Columbia, Vancouver, Canada. Grand Canyon conceptual model and stock assessment results: implications for experimental implementation of selective withdrawal from Glen Canyon Dam.

#### FIELD RESEARCH AND MONITORING

Susan Hueftle, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona –Water quality assessment in Lake Powell and the Colorado River.

Joe Shannon, Northern Arizona University, Flagstaff, Arizona. Assessing Aquatic Food Base Patterns over the Past Decade in the Colorado River below Glen Canyon Dam.

Wayne Gustaveson, Utah Department of Natural Resources, Page, Arizona.. The Lake Powell fishery.

Bill Persons, Arizona Game and Fish Department, Phoenix, Arizona. The Lee's Ferry trout fishery.

Lew Coggins, U.S. Fish and Wildlife Service, Flagstaff, Arizona. Native and non-native fish studies: Little Colorado River.

Rich Valdez, SWCA, Inc., Logan, Utah. Native and non-native fish studies: Colorado River mainstream.

Larry Stevens, Stevens Ecological Consulting, Flagstaff, Arizona.. Riparian communities and recreation.

#### **SUMMARY OF GENERAL RECOMMENDATIONS:**

Following the presentations, workshop participants held large group and small group discussions

to develop recommendations for research and monitoring to assess the effects of the temperature control device if it is constructed and operated. Some of those recommendations follow.

#### Monitoring and Management Actions Relative to the TCD

- Water temperature is modified as a consequence of modifying hydrology as evidenced in the experimental flows of year 2000: the two physical parameters should be considered together in planning and assessment of management actions
- Scientists need more lead time for design and implementation of research and monitoring assessments; water managers and scientists need to work more closely in planning studies

For the present discussion, the group defined two types of monitoring, core monitoring and effects monitoring. Evaluation of a TCD would require both types of monitoring. They were defined as follows:

- Core Monitoring – function is to measure status and trends of high priority resources; sampling schedule typically calendar driven; highly standardized, consistently applied methods and protocols, few changes once established
- Effects Monitoring – function is to measure environmental conditions and resource status before and after management actions are taken; sampling schedule typically event driven, set up to accommodate particular actions; more flexible methods and protocols

A vigorous discussion occurred in response to a suggestion that the existing sampling design for lower trophic level resources (algae and invertebrates) is statistically biased, i.e. sampling sites are not randomly selected and thus tests of significance can not legitimately be applied to the CRE. The Environmental Protection Agency's Environmental Monitoring and Assessment Program was put forth as an approach that might be used in Grand Canyon. Further conversation revealed that these same issues probably are present in sampling designs for physicochemical and fisheries studies. Participants had very mixed opinions concerning the significance of this decision, but it was clear that more discussion should occur before decisions on sampling designs are made for research and long-term monitoring in the CRE.

Much emphasis on detecting change in high priority fish populations in Grand Canyon is shifting to estimation of recruitment rate using a stock assessment and synthesis model. One complication of this index is that the estimate of recruitment rate for humpback chub can not occur until 2-3 years after initial marking. Since there is little year-to-year control over hydrology, the relationship between reproductive success, recruitment rate, and dam operations often will be confounded by intervening years of differing dam operations and, thus, hydrology. This discussion led to an attempt to identify other indicators of system change for different ecosystem components being measured in the CRE. The results of that exercise are contained in the following table:

Large Group Discussion on Indicators:

TEMPORAL INDICATORS OF CHANGE			
	Early <sup>1</sup>	Mid	Late
Physicochemical	Water temperature System metabolism Allochthonous input (reservoir) C:N stable isotope ratios		
Lower Trophic	Phytobenthic & macroinvertebrate benthic biomass New colonists	Phytobenthic community composition	Macroinvertebrate community composition
Rainbow Trout	Reproductive success, Growth, New colonists	Sustained range expansion, Growth, Disease/ parasites, Population estimates	
Native Fish	Change in distribution, Reproductive success, Growth, Small-bodied exotic numbers, New colonists	Sustained range expansion, Growth, Disease/ parasites, Population estimates	Recruitment rate, Second HBC population, Down- and delisting of T&E

<sup>1</sup> Scale of time frames for these indicators will vary for the different resource categories

### PRESENT STATUS OF TCD EVALUATION

In January 1999 Bureau of Reclamation released a draft environmental assessment on a temperature control device for Glen Canyon Dam. The preferred alternative was a single inlet, fixed elevation design with an estimated cost of \$15,000,000. Sufficient concern was evidenced in the review of the environmental assessment for unintended negative effects and the lack of a detailed science plan to measure those effects that the environmental assessment was withdrawn and not finalized.

A temperature control device workshop was convened in November 1999 to further develop issues surrounding the device and to work on development of the science plan. One outcome of the workshop was the discovery that native fish data had not been brought together and analyzed. Opinions of native fish biologists on the status of endangered humpback chub differed sufficiently to make obvious the need for the analysis. In response to this finding, GCMRC modified native fish field contracts for year 2000 and reprogrammed funds into data compilation, analysis, and

synthesis. This effort was complicated by the necessity of developing and carrying out the monitoring and research conducted as part of the experimental native fish flows in year 2000. At this time, GCMRC is in possession of all native fish data collected since 1990, and the analysis is underway.

During year 2000, Reclamation resource managers discovered that projections for utilization of the preferred alternative design for the temperature control device, previously estimated at 85 out of 100 years, were considerably overestimated and were closer to 45-50% of those years. This was a result of misinterpretation of computer modeling outputs. The discovery has forced re-evaluation of the engineering designs for the temperature control device.

Reclamation water quality modelers have undertaken analyses of release temperature deliveries with different engineering designs and have discovered that modification of a subset of the 8 inlets on Glen Canyon Dam may be sufficient to provide desired water temperatures.

Given these events and discoveries, it was decided to convene a second temperature control device workshop including scientists and resource managers who could provide knowledgeable input and recommendations on operation and assessment of effects to be integrated into the research and monitoring plan and the forthcoming environmental assessment. Full results of the recent TCD workshop, results of the GCMRC analysis, status of the development of the TCD research and monitoring plan, analysis of engineering designs for the TCD, and evaluation of the schedule for completion of the environmental assessment will be provided at the April 2001 AMWG meeting.