

Glen Canyon Environmental Studies: Pathway to Better Management of a Non-native Ecosystem

By Steve Hodapp

From its completion in 1964 until 1983, Glen Canyon Dam was operated to fulfill three primary goals: (1) minimizing releases in excess of 8.25 million acre feet (the amount required by the 1922 Colorado River Compact for release from Upper Colorado River Basin States to Lower Colorado River Basin States), (2) maximization of power revenues, and (3) filling of Glen Canyon reservoir. Short- and long-term impacts to Glen Canyon NRA and Grand Canyon National Park resources in the downstream river corridor were generally not considered in dam operations.

In the early 1980s, two events resulted in reconsideration of the manner in which the dam had been operated. These were: (1) the filling of the upper basin storage reservoirs and (2) a 1981 proposal by the Bureau of Reclamation (BR) to add two generators and increase maximum powerplant discharge from 31,500 cfs to 40,000 cfs. This rekindled the sentiment of the environmental and river-running community which had never recovered from the initial Glen Canyon Dam battle in the 1950s.

The compromise solution born from this BR proposal was an agreement to proceed with rewind of the existing eight generators, basically a maintenance function which would provide only a 5-percent increase in maximum powerplant discharge, along with initiation of a research project to study the impacts of existing and potential future powerplant releases. In December 1982, a tri-party, interagency agreement was signed (U.S. Fish and Wildlife Service, BR, and NPS) to create the Glen Canyon Environmental Studies (GCES). The agreement provided for BR to provide all funding and for all agen-

cies to jointly provide input on project direction. In addition, in that agreement BR agreed not to exceed the historic powerplant discharge of 31,500 cfs.

The GCES are a series of technical studies to determine the long- and short-term impacts of dam operations. The project has been subdivided into four major subteams: biological (both aquatic and terrestrial), recreational, sediment transport, and dam operations. Each of these subteams is composed of a number of researchers pursuing specific studies designed to determine the effects of different flow regimes on their particular resource of concern. In all, over 70 researchers are pursuing about 40 different studies (see Table 1). Researchers include: universities, graduate students, other Federal agencies, State agencies, private contractors, and NPS personnel. The primary area of NPS researcher involvement is studies focused on potential impacts to vegetation, boating safety, and avian habitat.

Unlike most government-sponsored studies, the major obstacle to testing of the various hypotheses has not been funding, but rather ensuring provision of an adequate time period of fluctuating flows. Due to extreme runoff in the Colorado River basin, there have been only 4 months over the 3½-year study period with fluctuating flows simulating those of "normal" dam operations. (Use of the term normal is still being redefined due to filling of the upper basin storage reservoirs in 1983.)

After the individual research reports were completed in the fall of 1986, they were being assimilated by an interagency team into four comprehensive subteam reports. The National Academy of Sciences has been contracted to provide technical input into this assimilation process and to ensure that study assumptions are fully considered.

A final report, integrating results of each of the subteam reports, will be completed by April 1987 and forwarded to the Secretary of the Interior who will make the ultimate decision on the dam release pattern. Any "major" change in operations would require NEPA documentation. This 1987 deadline coincides with the scheduled renegotiation of WAPA firm power contracts to provide fixed amounts of electricity to various utilities.

Any flow regime selected will require trade-offs among competing resource values. The NPS recommendation for an operational regime will be based on how well specific flow scenarios meet the hierarchical objectives proposed for the revised Colorado River Management Plan (see below).

Draft Prioritized Objectives for the Colorado River Management Plan

1. Protect and enhance existing populations of native aquatic organisms or allow for reestablishment of extirpated native species.
2. Maintain the Colorado River alluvial deposits by mitigating accelerated erosion due to man-induced processes.
3. Perpetuate the Colorado River riparian ecosystems and natural successional processes taking place within them.
4. Maintain the diverse wildlife communities that developed within the modified Colorado River riparian habitat.

Table I.
Reports to be Generated by the
Glen Canyon Environmental Studies

GROUP I – BIOLOGICAL STUDIES

A. Terrestrial

1. Impacts of the 1983 High Flows on New High Waterline Riparian Vegetation (NPS)
2. Description of Beach Edaphic Factors and Invertebrate Biology (NPS)
3. Impact of the High Flows on the Old High Water Line Plant Community (NPS)
4. Impacts of Fluctuating Flows on Grand Canyon Birds (NPS)
5. Analysis of Recent Vegetation Trends in the New and Old High Water Plant Community (BR)
6. Description of Factors Affecting Establishment of the Perennial Riparian Community Within the New High Water Zone (NPS)
7. Impact of Flows on the Reptiles of Grand Canyon (NPS)

B. Aquatic

1. Instream Flow Microhabitat Studies in the Lees Ferry Area (FWS)
2. Thermal Modeling of the Colorado River Through Grand Canyon (BR)
3. Mainstream Colorado River Fishery Study (AZ Game & Fish)
4. Tributary Fishery Studies (AZ Game & Fish)
5. Fish Reproduction Studies (AZ Game & Fish)
6. Fish Movement Studies (AZ Game & Fish)
7. Lees Ferry Fishery (AZ Game & Fish)
8. Cladophora Biology Study (No. Arizona University)
9. Gammarus Biology Study (No. Arizona University)
10. Analysis of Water Quality Parameters in the Mainstream and Tributaries (AZ Game & Fish)

GROUP II – RECREATIONAL STUDIES

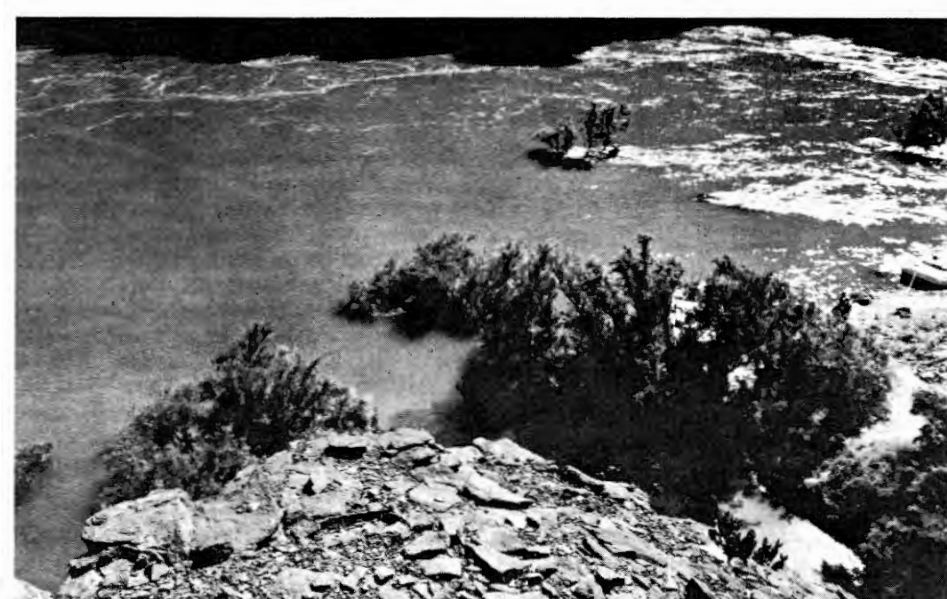
1. Correlation of Reported and Non-reported Accidents with Flow Level (NPS)
2. Utilization of the River Use Simulation Model to Predict Effects on Trip Structure (NPS)
3. Attribute Surveys (4 parts – Day-use Rafting, Whitewater Rafting, Fishing, Guides) (Private Consultant)
4. Contingent Valuation Surveys (3 parts – Day-use Rafting, Whitewater Rafting, Fishing) (Private Consultant)
5. Economic Modeling of Recreation Use

GROUP III – SEDIMENT TRANSPORT AND HYDROLOGY STUDIES

1. Model Development to Predict Suspended Sediment Transport (BR)
2. Survey of Colorado River Bed Material (USGS)
3. Analysis of Short- and Long-Term Geomorphic Relationships Affecting Beach/Bar Stability (USGS)
4. Critical Beach Topographical Surveys (BR)
5. Rapid Hydraulics Study (USGS)
6. Analysis of Historic Records from Gaging Stations Within Grand Canyon (NPS)

GROUP IV – OPERATIONS STUDIES

1. Colorado River Storage Project Constraints (BR)
2. Colorado River Water Law (BR)
3. Operations of Glen Canyon Dam (BR)



19.3 Mile Camping Beach is shown in the top photo as it appeared in June 1983, when the river flow was 60,300 cfs, and in the bottom photo as it looked in October 1983, when the water flow was down to 25,000 cfs. The high June runoff has scoured most of the tamarisk except for a few bedraggled plants and left the beach essentially barren.



5. Maintain the current water quality of the Colorado River.
6. Maintain specific features of the post-dam riverine system that are essential for river running and/or that enrich the experience.
7. Perpetuate the recreational trophy trout fishing in the absence of further impact by trout to existing native aquatic ecosystems.

This hierarchy of resource values has been established based on laws and policies directing resources preservation at Grand Canyon NP. These laws and policies include the 1916 Organic Act as amended by Public Law 95-250, which emphasizes resource preservation over visitor use, NPS management policies, and the Endangered Species Act. This prioritization of resource values is expected to raise interesting questions from a policy standpoint. For example, is an exotic riparian community (objective number 3) really more important than the whitewater rafting experience (objective number 6)? The surprising answer for a natural park such as Grand Canyon is yes. A further explanation of these objectives will

help provide a context for priorities.

The first objective speaks to protection of native species, in particular, the endangered humpback chub and, hence needs little explanation or justification to support its high priority. Objectives 2 through 5 relate to the riparian habitat along the Colorado River which has been identified as an important ecological niche within the park. The unique aspect of this riparian community is that in pre-dam times, the alluvial deposits, locally known as beaches, were barren of vegetation. This resulted from the spring runoff, which scoured beaches during the average annual floods of 100,000 cfs.

In post-dam times (except for relatively brief periods of flooding following the 1983 filling of the upper basin reservoir system), dam releases have been less than 30,000 cfs. The previously barren beaches have become available for colonization by plants and animals. The plans are mostly alien, as would be anticipated in a disturbed environment, but many of the birds are species that had experienced

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significant habitat loss elsewhere in the southwest due to riparian habitat destruction. At the same time, mammals and herptofauna have extended their habitat from the old high water vegetation community (mesquite-acacia) above the 100,000 cfs waterline to the new high water vegetation (tamarisk) above the 30,000 cfs waterline.

Therefore, we view preservation of beaches which are essential in providing a substrate for this habitat (as well as camping opportunities for river runners) as the most important component of this riparian system. The vegetation which provides the habitat is secondarily important and finally, the animals themselves. Next we look at the water quality which also has been substantially altered in physical/chemical properties by the dam. Existing parameters are important to current aquatic organisms as well as the river running community from a public health perspective. The recreational opportunities are the basis for the last two objectives. As would be expected, the popular river-running experience is higher priority than the exotic trout fishery.

It appears that the ongoing GCES will at least qualitatively identity the differing effects of various flow regimes on these downstream resources. It is also fully anticipated that maximization of various resource opportunities will require different flow regimes. For example, data could suggest beneficial effects of high spring flows on certain riparian plant species but detrimental effects on certain bird species that nest low to the ground. Some tradeoffs would be required under such a scenario in order to ensure preservation of the most important resource process.

The decision on benefits of particular flow regimes is expected to be further complicated by the different mandates of the various agencies participating in this interagency study. Due to these complexities, this priority list cannot be viewed as an absolute, but rather as a guide toward management of this system.

If effects of differing flows can be confirmed, the study methodology and potentially even the results may have broad applicability to maximizing protection of important resource values in other artificially regulated river corridors.

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