REPORT TO CONGRESS
OPERATIONS OF GLEN CANYON DAM
PURSUANT TO THE GRAND CANYON PROTECTION ACT OF 1992
FOR
2012-2013

Secretary of the Interior

November 2013

EXECUTIVE SUMMARY

This report by the Department of the Interior (Interior) is submitted pursuant to section 1804 of the Grand Canyon Protection Act (GCPA) of 1992, which provides

> Each year after the date of the adoption of criteria and operating plans pursuant to paragraph (1), the Secretary shall transmit to the Congress and to the Governors of the Colorado River Basin States a report, separate from and in addition to the report specified in section 602(b) of the Colorado River Basin Project Act of 1968 on the preceding year and the projected year operations undertaken pursuant to this Act.

This report provides an update from the last report, submitted by Interior for 2011-2012, and covers activities for 2012 and 2013.

INTRODUCTION

Glen Canyon Dam was authorized for construction by the Colorado River Storage Project Act of 1956. 43 U.S.C. § 620. The Dam was completed in 1963 and is operated by the Bureau of Reclamation (Reclamation). In 1992, Congress enacted the GCPA, which requires the Secretary of the Interior (Secretary) to operate Glen Canyon Dam

> [i]n accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use.

Congress also directed that such operations be undertaken

> in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in Arizona vs. California, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

In 1997, the Secretary established the Glen Canyon Dam Adaptive Management Program (GCDAMP) to carry out the requirements of the GCPA. As part of the GCDAMP, the Secretary also established the Adaptive Management Work Group (AMWG), a 25-member federal advisory committee that operates pursuant to the provisions of the Federal Advisory Committee Act, 5 U.S.C. § App. 2. The Secretary's Designee, currently Assistant Secretary for Water and Science Anne Castle, serves as the Chair of the AMWG.

STATUS REPORT

Five agencies within Interior have responsibilities under the GCPA and undertake operations pursuant to the GCPA; the: (1) Bureau of Indian Affairs (BIA); (2) Reclamation; (3) National Park Service (NPS); (4) United States Geological Survey (USGS); and (5) United States Fish and Wildlife Service (FWS). The Western Area Power Administration (Western) also has statutory responsibilities pursuant to the Department of Energy Organization Act, Flood Control Act, Reclamation Project Act, Colorado River Storage Project Act, and GCPA. The role of each responsible Interior agency under the GCPA is briefly addressed below.

Bureau of Indian Affairs

The BIA's mission, among other objectives, includes enhancing quality of life, promoting economic opportunity, and protecting and improving trust assets of Indian Tribes and individual American Indians. This is accomplished within the framework of a government-to-government relationship in which the spirit of Indian self-determination is paramount. As part of the AMWG, BIA works hand-in-hand with interested tribes and other participating agencies to ensure that this fragile, unique, and traditionally important landscape is preserved and protected.

Bureau of Reclamation

Reclamation operates Glen Canyon Dam in accordance with and subject to interstate compacts, an international treaty, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the "Law of the River", additional criteria and operating plans specified in section 1804 of the GCPA, and approved experimental plans. Reclamation also provides support to the Secretary's designee in administering the GCDAMP, including coordinating logistics for the AMWG and the Technical Working Group (TWG).

National Park Service

The NPS manages units of the national park system and administers resource-related programs under the authority of various federal statutes, regulations, and executive orders, and in accordance with written policies set forth by the Secretary and the Director of the NPS, including the NPS Management Policies 2006 and the NPS Director's Orders. The NPS manages Grand Canyon National Park and Glen Canyon National Recreation Area under the NPS Organic Act, 16 U.S.C. §§ 1 and 2-4, as amended; other acts of Congress applicable generally to units of the national park system; and the legislation specifically establishing those park units. 16 U.S.C. §§ 221-228j and 16 U.S.C. §§ 460dd through 460dd-9 (2006). The NPS Organic Act directs the NPS to "promote and regulate the use of . . . national parks . . . in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The NPS helps the Secretary achieve the goals outlined in the GCPA through its resource-management and resource-monitoring activities.

U.S. Geological Survey

The Grand Canyon Monitoring and Research Center (GCMRC) of the USGS was created to fulfill the mandate in the GCPA for the establishment and implementation of a long-term monitoring and research program for natural, cultural, and recreation resources of Grand Canyon National Park and Glen Canyon National Recreation Area. GCMRC provides independent, policy-neutral scientific information to the GCDAMP on (a) the effects of the operation of Glen Canyon Dam and other related factors on resources of the Colorado River ecosystem using an ecosystem approach, and (b) the flow and non-flow measures to mitigate adverse effects. The GCMRC's activities are focused on (a) monitoring the status and trends in natural, cultural, and recreational resources that are affected by dam operations, and (b) working with land and resource management agencies in an adaptive management framework to carry out and evaluate the effectiveness of alternative dam operations and other resource conservation actions described in this report.

Fish and Wildlife Service

The FWS provides Endangered Species Act (ESA) conservation and associated consultation and recovery leadership with various stakeholders primarily to benefit four listed species: the humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), southwestern willow flycatcher (*Empidonax trailii extimus*), and Kanab ambersnail (*Oxyloma haydeni kanabensi*).

2012 OPERATIONS

Bureau of Indian Affairs

In 2012, the BIA continued to consult with stakeholder tribes on formulating funding requests for various projects related to the adaptive management program. The BIA additionally participated in consultation meetings with the tribes regarding the Tribal Consultation Plan, conducted pre-meetings with tribal representatives prior to the AMWG meetings, and participated in ad hoc groups and other meetings regarding cultural and natural resources issues and concerns. Principal among tribal concerns for 2012 was the proposed removal and disposition of non-native rainbow trout as part of the efforts to reduce predation on humpback chub. The BIA was also involved with the high flow experimental protocol for the Glen Canyon Dam and coordination with the Tribes. The BIA continued to provide its portion of funding to tribes for their participation in the GCDAMP. In Fiscal Year 2012, the BIA also continued to serve as Cooperating Agency for Reclamation's two environmental assessments (EA's) - High-Flow Experimental Protocol and Non-Native Fish Control; participate on the Interior Native American Core Team and various GCDAMP Ad Hoc Groups; and review the development of the hydrograph for the annual operating plan (AOP) and GCDAMP efforts. The BIA is also a Cooperating Agency on the Long Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) process. Other activities included participating in development of the Memoranda of Agreement (MOA) for cultural resources, continued coordination of efforts for tribal participation in the GCDAMP, and attendance at the High Flow experimental release ceremony in Page, Arizona on November 19, 2012 in support of Interior and the stakeholder tribes.

Bureau of Reclamation

As in 2010 and 2011, a water year (WY) 2012 hydrograph was jointly developed by the Interior AMWG agencies and Western. The recommended hydrograph was consistent with the Law of the River (including the GCPA) and was designed to enhance protection of downstream resources. This approach to operations is consistent with the Interim Guidelines, operating criteria, or 2007 Record of Decision (ROD), and falls within the parameters of the modified low fluctuating flow (MLFF) alternative adopted in the 1996 ROD. The recommended hydrograph received broad support from the members of the AMWG and was approved by the Secretary on December 5, 2011.

Releases from Lake Powell in WY 2012 continued to reflect consideration of the uses and purposes identified in the authorizing legislation for Glen Canyon Dam and were consistent with the 1996 ROD, the 2008 EA/Finding of No Significant Impact for Experimental Releases for Glen Canyon Dam, Arizona, 2008-2012, and the 2012 hydrograph. The monthly release volumes for WY 2012 are displayed in Table 1. A steady flow regime (steady daily releases), as described in the Experimental Releases EA, was implemented in September 2011 and continued through the first month of WY 2012 (October 2011). These steady releases were approximately 15,500 cubic feet per second (cfs) during these two months. A steady flow regime of

approximately 8,030 cfs was also implemented for the last month of WY 2012 (September 2012). 2012 was the last year that steady flows were required under the EA.

Table 1. Lake Powell Monthly Release Volumes
Water Year 2012

Month	Monthly Release Volumes (maf*)
October 2011	0.956
November 2011	1.099
December 2011	1.223
January 2012	0.852
February 2012	0.653
March 2012	0.600
April 2012	0.606
May 2012	0.601
June 2012	0.709
July 2012	0.886
August 2012	0. 800
September 2012	0.481
Total Releases	9.466

*maf = million acre feet

Interior published a final EA on development of a High-Flow Experimental (HFE) Protocol for releases from Glen Canyon Dam on December 30, 2011, and a decision on the EA was issued in May 2012. HFE releases have been undertaken in the past and have been further analyzed to assess whether such releases will protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established. The GCDAMP federal agencies, Hopi Tribe, Hualapai Tribe, Zuni Pueblo, Arizona Game and Fish Department, and Upper Colorado River Commission were cooperating agencies in the process. A copy of the HFE Protocol EA and Finding of No Significant Impact may be found at *www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol*. Along with the HFE Protocol EA, Reclamation began an EA on Non-native Fish Control in 2010 that was finalized on December 30, 2011. The decision on the EA was issued in May 2012. The Non-native Fish Control EA evaluated alternatives for controlling non-native fish species that prey on and compete with native fishes including the endangered humpback chub. Non-native fish control is an important requirement and conservation measure of a biological opinion received from the FWS dated December 23, 2011. A copy of the Non-native Fish Control EA, including the December 23, 2011, BO as well as the Finding of No Significant Impact issued in May 2012, may be found at *www.usbr.gov/uc/envdocs/ea/gc/nnfc*.

The first experimental release under the new High-Flow Experimental Protocol was successfully conducted during November 2012. Reclamation released the maximum available capacity (43,000 cfs) during the experiment which began on November 18 and ended on November 23, 2012. Preliminary findings suggest that these releases were successful in transporting sediment accumulated near the confluence of the Colorado and Paria rivers to beaches and sandbars where sediment replenishment was needed.

In 2012, Reclamation and the NPS continued developing the LTEMP EIS, funded by Reclamation and using the Department of Energy's Argonne National Laboratory as the third party contractor. Public scoping for this EIS ended in January 2012 and a public webinar was held on March 27, 2012, to brief the interested public on scoping comments received. Participation by 14 entities as cooperating agencies was confirmed, including six tribes, and regularly scheduled cooperating agency meetings and conference calls occurred throughout the year. An alternatives development workshop open to the public was held in Flagstaff, Arizona, April 4-5, 2012, and alternatives development will continue into 2013. Seven government-to-government consultations with interested tribes were conducted throughout the year, and additional staff level meetings and conference calls with interested tribes were also held.

In addition to the high-flow experimental release and consultations for the LTEMP EIS, Reclamation continues to conduct government-to-government consultations with American Indian Tribes as part of the GCDAMP on operations of the Glen Canyon Dam and activities of the GCDAMP in services of its responsibilities, including those under Section 106 of the National Historic Preservation Act, Executive Order 13175, Secretarial Order 3206, and the November 5, 2009, Presidential Memorandum on Tribal Consultation.

In 2012, Reclamation continued to fund and support Grand Canyon National Park with several projects including humpback chub translocations in Havasu and Shinumo creeks, non-native fish removal in Bright Angel creek, fish surveys in the mainstem Colorado River, a staff position for the permitting office, cultural monitoring, and support staff to complete National Environmental Policy Act (NEPA) compliance for their Glen and Grand Canyon fish management plan.

Three monitoring trips were conducted in Shinumo to evaluate the success of translocations from three previous years. A total of 902 humpback chub have been translocated into Shinumo beginning in 2009 and continuing through 2011. Annual growth rates were comparable or higher than growth rates of humpback chub populations elsewhere in Grand Canyon and some Shinumo chubs have reached the minimum size and age for reproduction. Pit tag antennae indicate that high emigration rates occur shortly after the translocation, but 42 tagged Shinumo fish were recaptured in the mainstem Colorado. Trout have been removed as part of every monitoring trip and the structure of the trout population in Shinumo Creek has shifted from moderate numbers of larger fish to greater numbers of small and young-of-the-year fish. The next milestone for Shinumo will be the detection of spawning and successful reproduction. Initial fish community sampling in Havasu turned up a surprising 13 wild humpback chub and very few non-natives. In 2011, 243 young-of-the-year, pit tagged chubs were translocated into Havasu below Beaver Falls and in May 2012 an additional 300 were introduced to the creek. A follow up monitoring trip in October 2012 indicated that growth rates in Havasu have exceeded those found in other populations and about 50 percent of the chubs remained in the creek. Outmigration contributed to the loss, but some of these tagged chub were recaptured in the mainstem. Monitoring crews also continued development and testing on the Havasu Creek mobile pit tag scanning systems.

Translocations of humpback chub cannot currently be accomplished in Bright Angel due to the large numbers of brown and rainbow trout that inhabit the creek. Consequently, trout removal

efforts were increased in 2012. A fish weir to trap spawning brown trout near the confluence has been utilized for several years and a new and more effective weir was installed in 2012. The weir was maintained from late October into the first week of February. Two electrofishing trips were also conducted upstream of the weir in 2012 to intensify the trout removal effort. Every attempt is made to utilize the trout removed by these projects. The fish are either smoked or frozen and provided for human consumption.

The NPS and GCMRC worked together in 2012 to conduct fish surveys in the mainstem. The surveys showed that aggregations associated with the Shinumo and Havasu tributaries translocated chub had migrated into the mainstem. Sampling occurred downstream from the Little Colorado River on aggregations at Lava Chuar, Middle Granite Gorge, and Pumpkin Springs. These data will be used to make estimates of the mainstem humpback chub population and to improve the statistical analysis for capture probability and survivorship of humpback chub translocations in the tributaries. For additional information on humpback chub translocation efforts, see the NPS section below.

Grand Canyon NPS employs a permitting specialist and staff who review all proposals for projects to be completed in the park. The GCDAMP program through Reclamation provides these funds to offset the park's administrative burden. In 2012, twelve GCDAMP associated research and collection projects including tribal monitoring were permitted with a total of 4,036 user days.

Reclamation continued to fund five American Indian Tribes (Hopi, Hualapai, Pueblo of Zuni, Kaibab-Paiute, and the Navajo Nation) to participate and provide their perspectives to the GCDAMP. They identify and monitor traditional cultural properties and provide annual reports detailing their activities, findings, and monitoring data.

Reclamation worked with other agencies and tribes to sign and begin implementation of two MOAs to mitigate for adverse effects under Section 106 of the National Historic Preservation Act (NHPA) for the High-Flow Experimental Protocol and Non-native Fish Management described above. The consultation process leading to execution of these two MOAs included consensus determination of eligibility of the Grand Canyon as a Traditional Cultural Property for several tribes, at their request. Reclamation also continued its efforts with the signatories to update the 1994 Programmatic Agreement for operation of Glen Canyon Dam pursuant to the GCPA.

National Park Service

Three units of the NPS (Glen Canyon National Recreation Area, Grand Canyon National Park, and Lake Mead National Recreation Area) provided essential logistical support for implementation of the November 2012 HFE. The park units established individual Incident Command systems to manage and coordinate activities related to the HFE. Safety was the primary concern, with visitor information and outreach being the primary tool used to communicate the changes in flow release volumes from Glen Canyon Dam. Before and during the HFE, Glen Canyon National Recreation Area staffs were able to successfully work with the three concessionaires on Lake Powell to minimize impacts to their marina operations.

Archaeological/Cultural Resources

Grand Canyon National Park: Field work in 2012 consisted of condition assessment monitoring at 111 sites along the Colorado River. Sites with check dams were monitored and maintained to ensure continued site stability. Currently 29 sites along the river have check dams as a treatment to curtail or minimize additional erosion. Ground Penetrating Radar (GPR) was used to conduct subsurface mapping at five river corridor sites. This project is a pilot project to determine if GPR is an appropriate and effective management tool for prioritizing data recovery treatment recommendations. Staff also participated on two tribal monitoring river trips visiting archaeological sites and resources of concern with tribal members.

Data recovery occurred at one site adjacent to a major river and backpacker camp in conjunction with the Watershed Stewardship program. The archaeological site contained five prehistoric features including hearths and a possible subterranean pit structure. Data collection resulted in the documentation of three distinct occupations at this site; the transition to the agricultural period 1000 B.C. to A.D. 500, the Pueblo I and Pueblo II (A.D. 800-1150) periods. This project builds upon our expanding knowledge of use of the river corridor during the transition to more intensive agricultural practices.

Mitigation and management protocols were completed for the Colorado River Management Plan cultural resource program. These protocols will form the basis for monitoring and management park wide.

Glen Canyon National Recreation Area: Work in 2012 focused on coordination and consultation with Reclamation and associated Tribes concerning the identification and appropriate resolution of adverse effects resulting from the fall high flow. Field observations were conducted prior to, during, and following the high flow to assess the potential effects to cultural resources. While direct effects were not readily apparent, physical changes were observed suggesting the potential for impacts from future high flows. Three stationary photogrammetry stations were established to monitor erosion on ancient Glen Canyon terrace areas during the 2012 HFE.

Tribal Consultation

In 2012, the NPS continued to participate in consultation meetings with the various tribes who are directly involved in the GCDAMP and other Colorado River related program. Grand Canyon National Park and Glen Canyon National Recreation Area staff continued discussions with tribes to incorporate tribal perspectives into the NPS Fish Management Plan, expected to be completed in spring 2013. Tribal advisors were consulted on specific monitoring and mitigation protocols relative to Grand Canyon National Park's Colorado River Management Plan (CRMP) implementation.

The NPS worked with Reclamation to consult with interested tribes involved in the LTEMP. Consultation is government-to-government and includes all tribes who are interested in the planning effort regardless of their role as a Cooperating Agencies for the EIS.

Humpback Chub Translocation and Fisheries Management

In 2012, the NPS (Grand Canyon National Park and Glen Canyon National Recreation Area) worked with various agencies and the interested public on a comprehensive fish management plan to address management of native fish within Grand Canyon National Park and sport fish management in the Lees Ferry area of Glen Canyon National Recreation Area. The fisheries management plan will evaluate future goals, objectives, and non-dam related management actions to meet NPS objectives in both NPS units.

The Bright Angel Creek non-native fish removal efforts were continued and expanded, and translocations and/or associated monitoring were completed at Havasu and Shinumo creeks.

Wildlife Surveys and Monitoring

In 2012, Grand Canyon National Park activities included monitoring for the southwestern willow flycatcher and California condor, and a desert bighorn sheep genetic study. Mountain lion research continued on the North rim and inner-canyon including radio tracking and kill site investigation.

In 2012 Glen Canyon National Recreation Area, wildlife surveys and monitoring included:

- Assisted the Peregrine Fund with monitoring a California condor nest located near Waterholes Canyon.
- Assisted NPS and Oregon State University researchers with desert bighorn sheep monitoring efforts.
- Worked with the Grand Canyon Wildlands Council and partners to plan possible northern leopard frog and Niobrara ambersnail translocation efforts at Leopard Frog Marsh (RM -9.0 L).
- Worked with the Grand Canyon Wildlands Council and partners to plan possible northern leopard frog translocation efforts at Hidden Slough (RM -6.5 R).

Vegetation Management/Exotic Species Removal

In 2012, NPS staff continued to implement priority sites, and expand plant collection and propagation efforts in preparation for watershed restoration projects. Grand Canyon National Park park restoration biologists finalized the Backcountry Restoration Handbook, a comprehensive document that contains protocols and methods for site restoration along the river corridor. Staff and volunteers continued to document and remove high priority invasive plant species from the river corridor and continued to expand hands-on stewardship opportunities. Staff continued to work with partners to document northern tamarisk beetle (*Diorhabda carinulata*) presence and tamarisk defoliation in the river corridor to ensure that the results are readily available to the public. Specifics accomplishments in Grand Canyon National Park included:

- Installed and read six vegetation transects at Granite Camp to record pre-work conditions prior to tamarisk removal and native plant restoration.
- Continued the Adopt-a-Camp program - Worked with several individuals, NPS boatshop, Grand Canyon Youth, and commercial companies to remove priority exotic plant species from the camps and attraction sites.
- Collected and propagated cottonwoods, coyote willow, Goodding's willow, red willow, mesquite, acacia, hackberry, sacred datura, and brittlebush for planting at Granite Camp.
- Began camelthorn control trials at three sites, testing method of cutting the plants and putting a drop of herbicide on the stem.
- Revised and updated draft desired conditions for vegetation in the river corridor.
- Continued northern tamarisk beetle and weevil sampling and tamarisk defoliation mapping on five river trips
- Removed the following exotic plant species:
  - ✓ African mustard – 6,167 (from along the river and at camps)
  - ✓ Camelthorn - 8,536 (from camps and attraction sites)
  - ✓ Perennial pepperweed - 181 (from along the river corridor)
  - ✓ Ravenna grass - 78 (from along the river corridor)
  - ✓ Red brome - 5,490 (at Granite Camp)
  - ✓ Russian olive - 5 (along river corridor)
  - ✓ Russian thistle -1,814 (from camps and at attraction sites)
  - ✓ Sahara mustard - 45,791 (from along the river corridor and at Lees Ferry)
  - ✓ Silverleaf nightshade - 558 (from camps and along river corridor)
  - ✓ Tamarisk - 770 (at Granite camp)
  - ✓ Yellow sweetclover - 69 (from camps)

2012 Glen Canyon National Recreation Area, vegetation management accomplishments include:

- Continued tamarisk leaf beetle (TLB) monitoring at Lees Ferry permanent plot (RM 0 R) to study the effectiveness of the beetle suppressing tamarisk and study impacts to other vegetation.
- Continued invasive non-native plant species mapping efforts.
- Continued planning and implementation of ecological restoration efforts at Hidden Slough and Leopard Frog Marsh.
  - ✓ Worked with Grand Canyon Youth and Grand Canyon Wildlands Council to control invasive non-native species and restore native species at Hidden Slough Project participants planted 70 Goodding's willow, 25 rabbitbrush, and 200 purple three-awn.
  - ✓ Worked with Grand Canyon Wildlands Council to produce Draft Aquatic Habitat Enhancement and Restoration Workplans.
  - ✓ Continued to propagate Goodding's willow, rabbitbrush, four-wing saltbush, purple three-awn, and Indian ricegrass for future planting efforts.
- Worked with Grand Canyon Trust volunteers to control 98 tamarisk at the Lees Ferry 10-acre restoration site.
- Planted the following native plants in disturbed areas adjacent to the new Petroglyph Beach (RM -10.4 L) toilets: 182 Indian ricegrass, 18 four-wing saltbush, 37 hairy false goldenaster, and 200 James' galletta grasses.

- Continued planning and implementation of the Federal Highway Administration (FHWA) Lees Ferry Access Road and Paria River Bridge Stabilization improvement projects.
    - ✓ Continued seed collection and plant propagation efforts.
    - ✓ Installed repeat photo monitoring points along roadway and bridge areas.
    - ✓ Developed *draft* Interagency Agreement with Natural Resources Conservation Service (NRCS) for plant material productions.
- Worked with Colorado River Discovery to clean-up debris/trash at day use and campground sites.

Research Review and Permitting

In 2012, Grand Canyon National Park's Research Office received 17 river trip applications to fulfill obligations under the GCDAMP. This represented a slight increase over 2011. The GCMRC was issued 6 research and collection permits and 11 stand-alone river permits, totaling 3029 administrative river user days. For each GCMRC and Tribal permit, an interdisciplinary team of technical experts reviewed and provided comments on the research proposal or logistics and assistance was given to the Principal Investigator in completing the Minimum Requirement Analysis (MRA) and related NEPA/NHPA compliance documents. Updating of annual investigator reports was done for each research permit and coordination with Reclamation will continue. Glen Canyon National Recreation Area administered 19 active research proposals that specifically support of the GCPA during 2012.

In addition to the GCMRC requests identified above, 5 tribal research permits with corresponding river trips were reviewed and processed for the Hopi, Hualapai, Navajo, Paiute, and Zuni tribes, totaling 1007 administrative river user days. Overall, 4036 user days were spent on the river conducting GCDAMP-related research and monitoring in disciplines such as sediment storage and morphology, near-shore ecology, mainstem Colorado fish monitoring, and tribal cultural monitoring.

Resource Monitoring and Mitigation

In 2012, the Grand Canyon National Park staff continued the integrated campsite monitoring and mitigation program. The trip conducted in late November, following the HFE included photographic documentation of campsites, and campsite rehabilitation projects in areas above the 25,000 cfs flow line and pre-dam highwater areas. The river trip was expanded to include rapid assessment of selected river camps and sandbars as part of evaluating the immediate effects of the High Flow Experiment. Staff from the GCMRC and a GCDAMP TWG member participated in the trip.

Grand Canyon National Park, through a cooperative agreement with Northern Arizona University, completed analysis of campsite resource condition monitoring data collected from 2007-2011. The results will be used to identify resource conditions and trends, clarify management questions, refine the study design and survey methods, and reinitiate annual monitoring in 2013.

Glen Canyon National Recreation Area staff continued the multi-faceted efforts to prevent Aquatic Invasive Species (AIS) transport to and from Lake Powell and Lees Ferry. AIS present extreme potential impacts to a wide range of GCPA associated resources.

Greater Grand Canyon Landscape Assessment

In 2012, an interdisciplinary team of NPS experts, agency partners, scientists, and other groups and individuals initiated an ambitious project to conduct the Greater Grand Canyon Landscape Assessment in an effort to identify resource conditions and trends and prioritize conservation needs to facilitate ecosystem-based stewardship. The NPS will complete a pilot riparian rehabilitation project at Granite Camp, including the removal of non-native tamarisk and revegetation with native plants. Glen Canyon staff continued monitoring and partnerships associated with the hidden slough vegetation restoration.

U.S. Geological Survey

U. S. Geological Survey / Grand Canyon Monitoring and Research Center

In 2012, the GCMRC continued to play its role as the primary science provider to the GCDAMP. The GCMRC's primary activities during 2012 were (1) providing workshops that summarized and synthesized knowledge-to-date concerning the Colorado River ecosystem, (2) development of the FY13/14 Biennial Work Plan (BWP), (3) implementation of a stream flow and sediment transport measurement program that was the foundation for planning the November HFE, (4) analysis of those data so as to inform dam and river management activities in the months immediately before the HFE, (5) collection and reporting of data describing resource condition immediately following the HFE, and (6) collection and reporting of native and nonnative fish population data in support of management decisions regarding nonnative fish control. Additionally, the GCMRC staff conducted numerous field and laboratory studies as anticipated in the FY11/12 BWP.

Knowledge Synthesis:

In January 2012, GCMRC concluded a series of workshops during which recent knowledge in key resource areas was presented in the context of previous Grand Canyon research. The foci of the January meeting were hydrology, sediment transport, geomorphology, cultural resources, and recreation resources. A session focused on biological and ecological research and monitoring conducted by cooperating agencies was also included. All material presented the workshops was made available in electronic postings at the GCMRC and Reclamation websites.

Development of the FY13/14 BWP

An important part of GCMRC's activities was the development of the FY13/14 BWP. In contrast to previous years, the FY13/14 BWP was organized into a relatively small number of focused projects, and the proposed budget for each project fully reflected the projected salary, logistics, and remote sensing support. Ten projects were proposed, of which 5 concerned study of fish resources (Fig. 1); approximately 45 percent of the total GCMRC monitoring and research budget is now focused on fish and aquatic ecology. The total budget for GCMRC GCDAMP-related monitoring and research activities is approximately $10.45 million, funded by GCDAMP funds and supplemental funding from Reclamation carryover funds ($9.52 million) and GCMRC carryover funds ($0.93 million). Approximately 30percent of the GCMRC budget supports salaries of its employees and a similar proportion supports of work of other USGS offices and non-USGS cooperators and contractors (Figure 2).

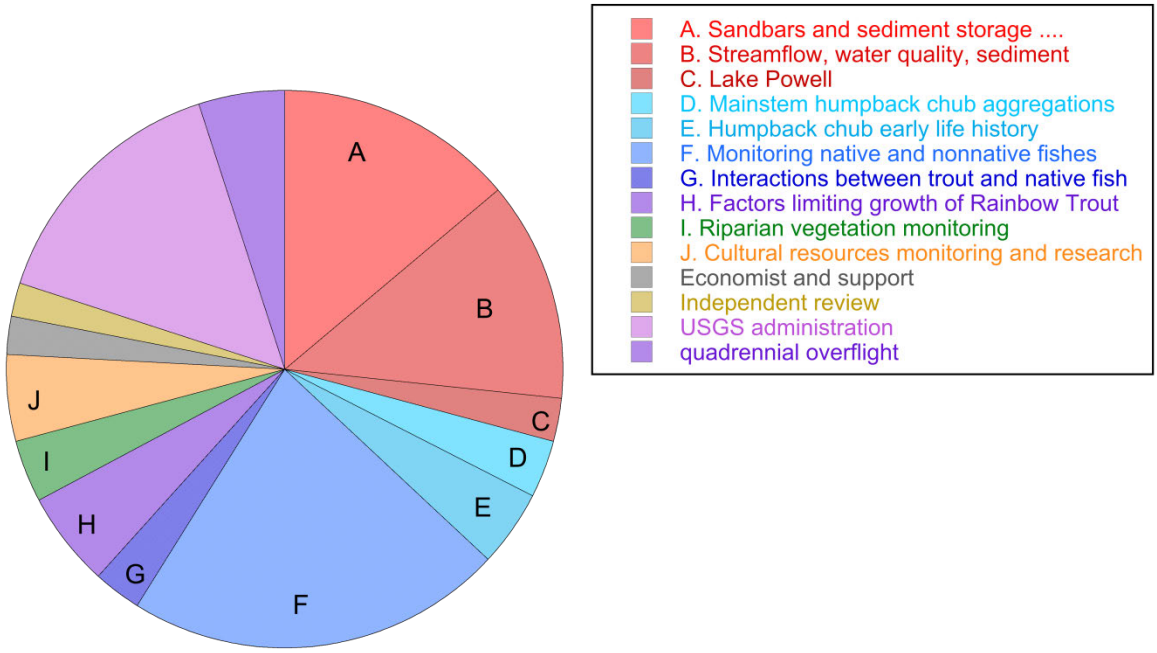

Figure 1: Proportional allocation of the GCMRC FY13 budget among 10 monitoring and research projects (projects A – J) as well as other activities.

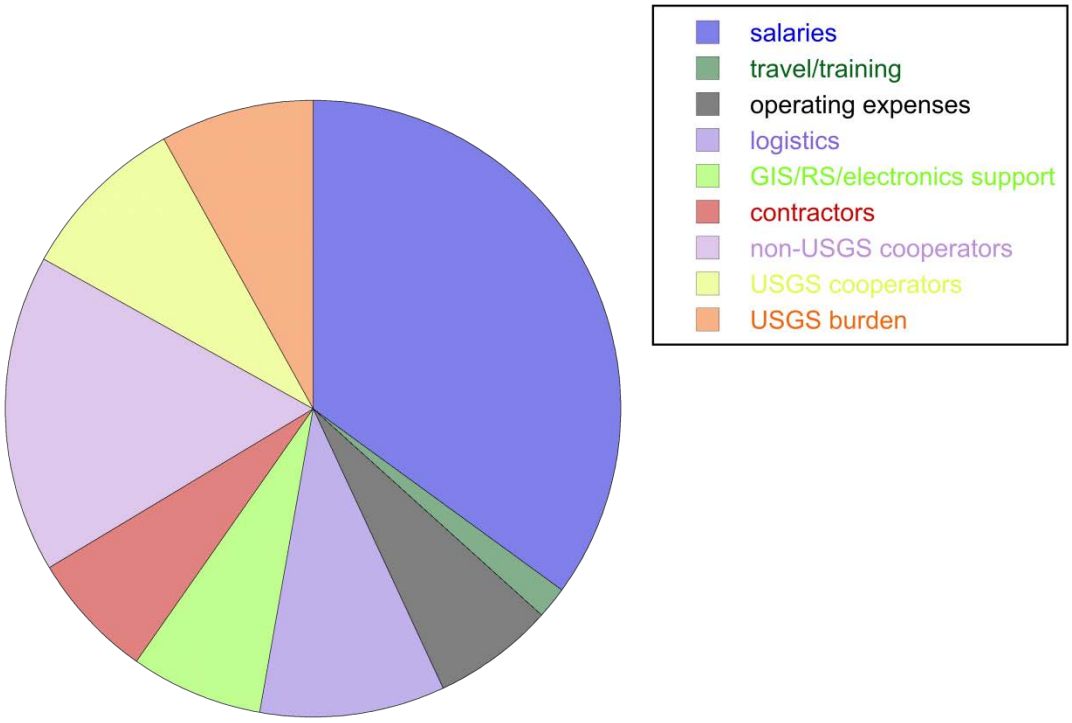

Figure 2: Proportional allocation of the FY13 GCMRC budget among general budget categories.

Implementation of Stream-flow and Sediment Measurement Program in Support of HFE Protocol

The period July 1 to November 1, 2012, marked the first "sediment accumulation period," as defined under the HFE Protocol that was adopted by the Secretary earlier in 2012. This HFE Protocol necessitates the estimation in real time of fine sediment delivery from the Paria River and fine sediment retention in Marble Canyon in the months immediately prior to the HFE. The GCMRC worked in collaboration with the Arizona and Utah Water Science Centers to measure suspended sediment transport and to process field samples in the GCMRC sediment lab. Data were shared with `Reclamation on a monthly basis in an unprecedented effort to provide sediment data in a real time format for HFE planning purposes. GCMRC staff estimated that between 617,000 and 769,000 metric tons of fine sediment were delivered from the Paria River to the Colorado River during the period between July 1 and November 17, 2013. The HFE began on November 18.

Analyses of Sediment Transport Data to Inform HFE Planning and Design

GCMRC scientists evaluated sediment transport and sediment mass balance data and made recommendations to the Bureau of Reclamation concerning the design of the HFE hydrograph so as to provide the most effective benefit to resource condition and to scientific learning, consistent with the protocol defined in the published Environmental Assessment. Following consideration by Reclamation and vetting with various stakeholders, this hydrograph was the one implemented in the November HFE.

Implementation of a Plan to Evaluate HFE Effects

GCMRC utilized a network of field time-lapse cameras to evaluate the effects of the HFE on sand bars throughout the Colorado River ecosystem. Teams of scientists were sent into the field in late November and early December to collect photographic data and recover gaging station data. The plan of field activities was somewhat more than had been anticipated in the Science Plan appended to the EA, and was responsive to increasing stakeholder interests. Preliminary results indicate that there was favorable bar building in Marble Canyon caused by the HFE. The first presentation concerning the effects of the HFE was made to the Upper Colorado River Commission at its Las Vegas meeting in mid-December. In addition, rainbow trout populations and the aquatic food base in Glen Canyon were sampled before and after the HFE to evaluate any effects on the aquatic ecosystem of the event. Results and analysis of these data are in progress.

Fisheries Information in Support of Nonnative Fish Control EA

GCMRC conducted monitoring of native and nonnative fish populations in support of Reclamation's Nonnative Fish Control EA and its associated Biological Opinion for endangered humpback chub. This Biological Opinion identifies several triggers which if met require management actions be taken to reduce nonnative fish populations in an effort to protect humpback chub. Information provided by GCMRC for specific triggers includes the abundance of nonnative rainbow trout and brown trout in the Colorado River near the Little Colorado River confluence. GCMRC and its cooperators also generated estimates of the abundance of several life stages of humpback chub in the Little Colorado River itself and near its confluence in the Colorado River as well as survival rates of juvenile humpback chub in this latter area.

Other Science Activities and Findings

In the course of its regular and mandated science monitoring and research activities, GCMRC and its cooperators provided stakeholders and the GCDAMP program with critical data concerning the status and trends of endangered humpback chub populations in the Colorado River downstream of Glen Canyon Dam as well as key tributaries, the status and trends of the rainbow trout fish community in Glen Canyon, Marble Canyon, and near the Little Colorado River confluence, the distribution and relative abundance of potentially harmful nonnative fish species between Glen Canyon Dam and Lake Mead reservoir, and the status and trends of the aquatic foodbase in the Colorado River ecosystem.

Fish and Wildlife Service

With the release of a final biological opinion on December 23, 2011, the FWS completed ESA Section 7 consultation work associated with the HFE Protocol and Non-Native Fish Control EAs proposed by Reclamation. The FWS will continue with this effort by assisting Reclamation and

interested tribes in development of the Memoranda of Understanding in regard to the NHPA and these two proposed actions.

The FWS accepted the opportunity to have cooperating agency status to participate in the LTEMP for the Glen Canyon Dam EIS on January 4, 2012. The FWS also provided scoping comments on January 18, 2012, and has participated in LTEMP meetings including alternatives development and will continue to be actively engaged in the EIS process. In both the FWS' acceptance of cooperating agency status and scoping comments it continued to recommend that FWCA considerations be incorporated into the EIS planning process in order to adequately assess effects on endangered species, other native fish that are not listed, migratory neotropical songbird use of riparian habitat, waterfowl and other bird use of wetlands and aquatic habitats, and management of the Lees Ferry trout fishery.

The FWS will continue to provide technical assistance in the development of desired future conditions to support the NPS management work for the Grand Canyon National Park and Glen Canyon National Recreation Area, and continue to participate in the AMWG, its TWG, and various ad hoc groups and other related assignments.

In 2012, the FWS conducted 4 monitoring trips into the Little Colorado River to generate population estimates for humpback chub, and to monitor trends of other native fishes. Since 2006, the Little Colorado River population of humpback chub in Grand Canyon has significantly increased in size, and continues to remain stable at elevated levels. FWS conducted 1 trip into the Little Colorado River to monitor the success of upstream translocations of humpback chub within the Little Colorado River. These translocation efforts have been successful, with humpback chub experiencing high growth rates, good survival, and retention (range expansion) in this upper portion of the river. FWS has continued to work collaboratively with Grand Canyon NPS and the Havasupai Tribe to monitor Havasu Creek, and completed a second translocation of humpback chub into Havasu Creek in spring 2012. FWS has continued to work collaboratively with the Southwest Native Aquatic Resources and Recovery Center in Dexter, New Mexico (Dexter) to establish a captive refuge of humpback chub for purposes of genetic conservation of the species. Thus far, about 1,000 humpback chub for this purpose are being held on station at Dexter. An additional 500 humpback chub collected in 2012 are also on station at Dexter and will be held until they are large enough to be marked with a small tag and translocated in 2013. FWS has successfully worked with the GCMRC to initiate a pilot study for collecting small, larval stage humpback chub for use in future translocation efforts. Finally, the FWS has taken the lead, and has worked collaboratively with GCMRC and NPS to develop and refine a monitoring program to effectively sample mainstem aggregations of humpback chub in the Colorado River in Grand Canyon. In 2012, FWS, GCMRC and NPS conducted one sampling trip to estimate the population size of humpback chub in these aggregations. It is encouraging that the effect of translocating humpback chub into Shinumo and Havasu creeks has resulted in a measurable augmentation of these two mainstem aggregations.

2013 OPERATIONS

Bureau of Indian Affairs

In 2013, the BIA will continue to take an active role in supporting stakeholder tribes related to the adaptive management program. The BIA will participate in meetings concerning the Tribal Consultation Plan, pre-meetings with tribal representatives prior to AMWG meetings, attend TWG meetings and continue to participate in various Ad Hoc groups regarding tribal cultural and natural resources issues and concerns. The BIA is also a Cooperating Agency on the LTEMP EIS and will be activity involved in that process. The BIA will also continue to be involved with any future HFE releases from Glen Canyon Dam.

Bureau of Reclamation

As in 2010, 2011, and 2012, a 2013 hydrograph was jointly developed by the Interior AMWG agencies and Western. The recommended hydrograph was consistent with the Law of the River (including the GCPA) and was designed to enhance protection of downstream resources. This approach to operations is consistent with the Interim Guidelines, operating criteria, or 2007 ROD, and falls within the parameters of the MLFF alternative adopted in the 1996 ROD. The recommended hydrograph received broad support from the members of AMWG and was approved by the Secretary on January 15, 2013.

Releases from Lake Powell in WY 2013 continued to reflect consideration of the uses and purposes identified in the authorizing legislation for Glen Canyon Dam and were consistent with the 1996 ROD, the 2008 EA/Finding of No Significant Impact for Experimental Releases for Glen Canyon Dam, Arizona, 2008-2012, and the 2013 hydrograph. The monthly release volumes for WY 2013 are displayed in Table 2. A steady flow regime (steady daily releases), as described in the Experimental Releases EA, of approximately 8,030 cfs was implemented for the first month of WY 2013 (October 2012). This regime was part of a two-month steady flow experiment that began on September 1, 2012. 2012 was the last year that steady flows were required under the EA. The end of water year 2013 elevation for Lake Powell was 3,951 feet.

Table 2. Lake Powell Monthly Release Volumes
Water Year 2013

Month	Monthly Release Volumes (maf)
October 2012	0.498
November 2012	0.730
December 2012	0.801
January 2013	0.801
February 2013	0.600
March 2013	0.601
April 2013	0.551
May 2013	0.602
June 2013	0.800
July 2013	0.848
August 2013	0. 801
September 2013	0.600
Total Releases	8.232

In 2013, Reclamation and the NPS will continue development of the LTEMP EIS leading to publication of a draft document. In addition, the second experimental release under the High-Flow Experimental Protocol was successfully conducted during November 2013. Reclamation released the maximum available capacity (35,000 cfs) during the experiment which began on November 11 and ended on November 16, 2013.

Reclamation will continue to provide funding to the NPS for fish studies and other activities in Grand Canyon National Park and for participation of five American Indian Tribes in the GCDAMP (as described above for 2012), and will continue efforts to update the 1994 Programmatic Agreement for operation of Glen Canyon Dam pursuant to the GCPA.

National Park Service

Archaeological/Cultural Resources

For 2013, mitigation protocols are scheduled to be finalized for the Colorado River Management Plan cultural resource program. These protocols will be used by the upcoming Backcountry management plan currently being drafted by the NPS. Data collected for the CRMP program are currently being analyzed by an NPS cooperator and intended to streamline and improve data collection for this program.

Program staff plan on integrating previously collected river corridor ethnographic information into the NPS database to allow better information tracking and retrieval of tribal recommendations for park management.

Tribal Consultation

In 2013, the NPS anticipates continued participation in consultation meetings with the various tribes who are directly involved in the GCDAMP and other Colorado River related programs. Grand Canyon National Park and Glen Canyon National Recreation Area staff will continue discussions with tribes to incorporate tribal perspectives into implementation of the NPS Comprehensive Fish Management Plan. Tribal advisors will continue to be consulted on specific monitoring and mitigation protocols relative to the CRMP implementation. Grand Canyon National Park staff anticipates working with the Pueblo of Zuni and external partners on a project to better protect an important site along the Colorado River.

The NPS will continue to work with Reclamation to consult with interested tribes involved in the LTEMP. Consultation is government-to-government and includes all tribes who are interested in the planning effort regardless of their role as a Cooperating Agencies for the EIS.

Humpback Chub Translocation and Fisheries Management

In late 2013, the NPS (Grand Canyon National Park and Glen Canyon National Recreation Area) completed a comprehensive fisheries management plan to address management of native fish within Grand Canyon National Park and sport fish management in the Lees Ferry area of Glen Canyon National Recreation Area. The Environmental Assessment has been completed and implementation of the plan will take effect after the Finding of No Significant Impact is signed.

Wildlife Surveys and Monitoring

In 2013 activity will focus on monitoring for California condor, canyon nesting Mexican Spotted Owls, and desert bighorn sheep research (e.g. genetic study and movement data). Mountain lion research will also continue on the North Rim and inner-canyon including radio tracking and kill site investigation.

2013 Glen Canyon National Recreation Area Wildlife Surveys and Monitoring Plans

- Continue to assist with California condor monitoring efforts.
- Continue to assist NPS and Oregon State University researchers with desert bighorn sheep monitoring efforts.
- Continue northern leopard frog and Niobrara ambersnail translocation planning for Leopard Frog Marsh project.
  Finalize northern leopard frog translocation planning for Hidden Slough project.

Vegetation Management/Exotic Species Removal

In 2013, NPS staff, partners, and volunteers will continue to implement management actions for priority exotic plant species. Staff and volunteers will continue to document and remove high priority invasive plant species from the river corridor and Grand Canyon staff will expand hands-on stewardship opportunities through the Adopt-a-Camp project. Staff will continue to collect seed and cuttings for native plant propagation for watershed restoration projects. Staff, partners, and volunteers will plant native riparian species at Granite Camp and will continue to mitigate human impacts at other high priority campsites in the river corridor. Staff will continue to document northern tamarisk beetle (*Diorhabda carinulata*) presence and tamarisk defoliation in the river corridor, but the effort will be scaled back this year due to its already widespread distribution in the corridor. Glen Canyon staff will continue partnerships and monitoring associated with the Hidden Slough restoration site and a potential restoration at Leopard Frog Marsh.

2013 Glen Canyon National Recreation Area Vegetation Management Plans

- Continue tamarisk leaf beetle monitoring at Lees Ferry permanent plot to study the effectiveness of the TLB in suppressing tamarisk and study TLB impacts to other vegetation.
- Continue invasive non-native plant species mapping and control efforts.
- Continue planning and implementation of ecological restoration efforts at Hidden Slough and Leopard Frog Marsh.
- Begin implementation of the FHWA Lees Ferry Access Road and Paria River Bridge Stabilization improvement projects.
    - ✓ Continue seed collection, cuttings collection, and plant propagation efforts.
    - ✓ Read repeat photo monitoring points along roadway and bridge areas.
    - ✓ Finalize Interagency Agreement with NRCS for plant material productions.
    - ✓ Control invasive non-native plants.

Research Review and Permitting

NPS staff anticipates continuation of research and permitting activities in 2013 at similar levels as 2012. For each of the research projects in support of the GCPA, peer review of the proposals, evaluation of need for NEPA and completion of Minimum Requirement Analysis (MRA) will be completed. Updating of annual investigator reports will be done for each research permit and coordination with Reclamation will continue.

Resource Monitoring and Mitigation

GCNP staff will continue integrated campsite monitoring in 2013 to include mapping of campable area at select sites. The NPS will continue to conduct campsite use surveys and attraction site monitoring. Two mitigation trips are planned to concentrate on campsite impacts in areas above the 25,000 cfs flow line and pre-dam highwater areas in Grand Canyon. This work will be completed in cooperation with the Grand Canyon outfitters

Greater Grand Canyon Landscape Assessment

In 2013, an interdisciplinary team of NPS experts, agency partners, scientists, and other groups and individuals will continue to conduct the Greater Grand Canyon Landscape Assessment in an effort to identify resource conditions and trends and prioritize conservation needs to facilitate ecosystem-based stewardship. The NPS will continue to work on a pilot riparian rehabilitation project at Granite Camp, including the removal of non-native tamarisk and revegetation with native plants.

U.S. Geological Survey

The major focus of GCMRC's activities in 2013 is on completion of all work tasks described in the FY 2013/2014 BWP. Additionally, GCMRC plans to improve its capability to provide scientific data needed to implement the HFE Protocol. Specifically, GCMRC plans to improve its webserver capabilities in providing estimates of the mass of fine sediment supplied to the Colorado River by the Paria and Little Colorado Rivers and the mass of fine sediment stored in various parts of Marble and Grand Canyon. GCMRC plans on working with Reclamation engineers in refining HFE planning protocols. GCMRC is providing science support in planning and developing the LTEMP EIS.

Fish and Wildlife Service

In 2013, the FWS will conduct up to 8 monitoring trips into the Little Colorado River to generate population estimates for humpback chub and other native fishes, but to also monitor the success of upstream translocations. The FWS will continue to work cooperatively with the NPS and the Havasupai Tribe on monitoring Havasu Creek and completing additional translocations of humpback chub in spring 2013. Fish will be collected for translocations effort from the Little Colorado River and held at the Southwest Native Aquatic Resources and Recovery Center until they are large enough to be marked with a small tag. The FWS will continue to take the lead on developing a monitoring protocol for effectively sampling the mainstem aggregations of humpback chub and will conduct two sampling trips in 2013.