

Summary

Lees Ferry Recreational Trout Fishery Management Recommendations

Goals:

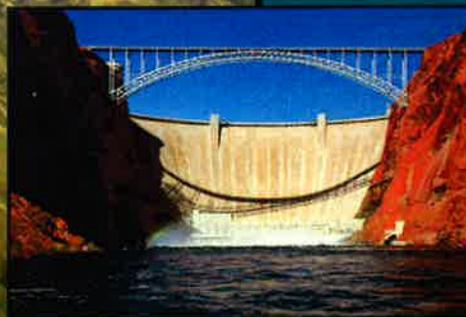
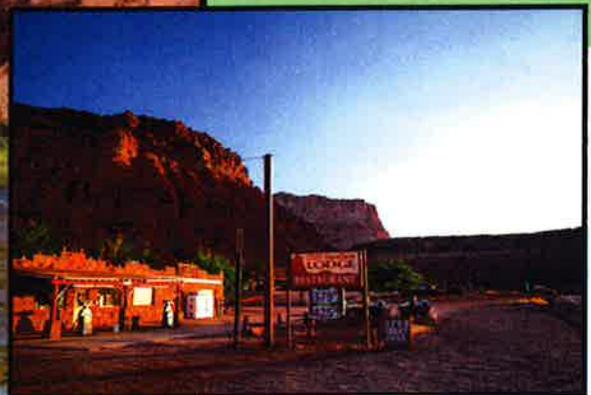
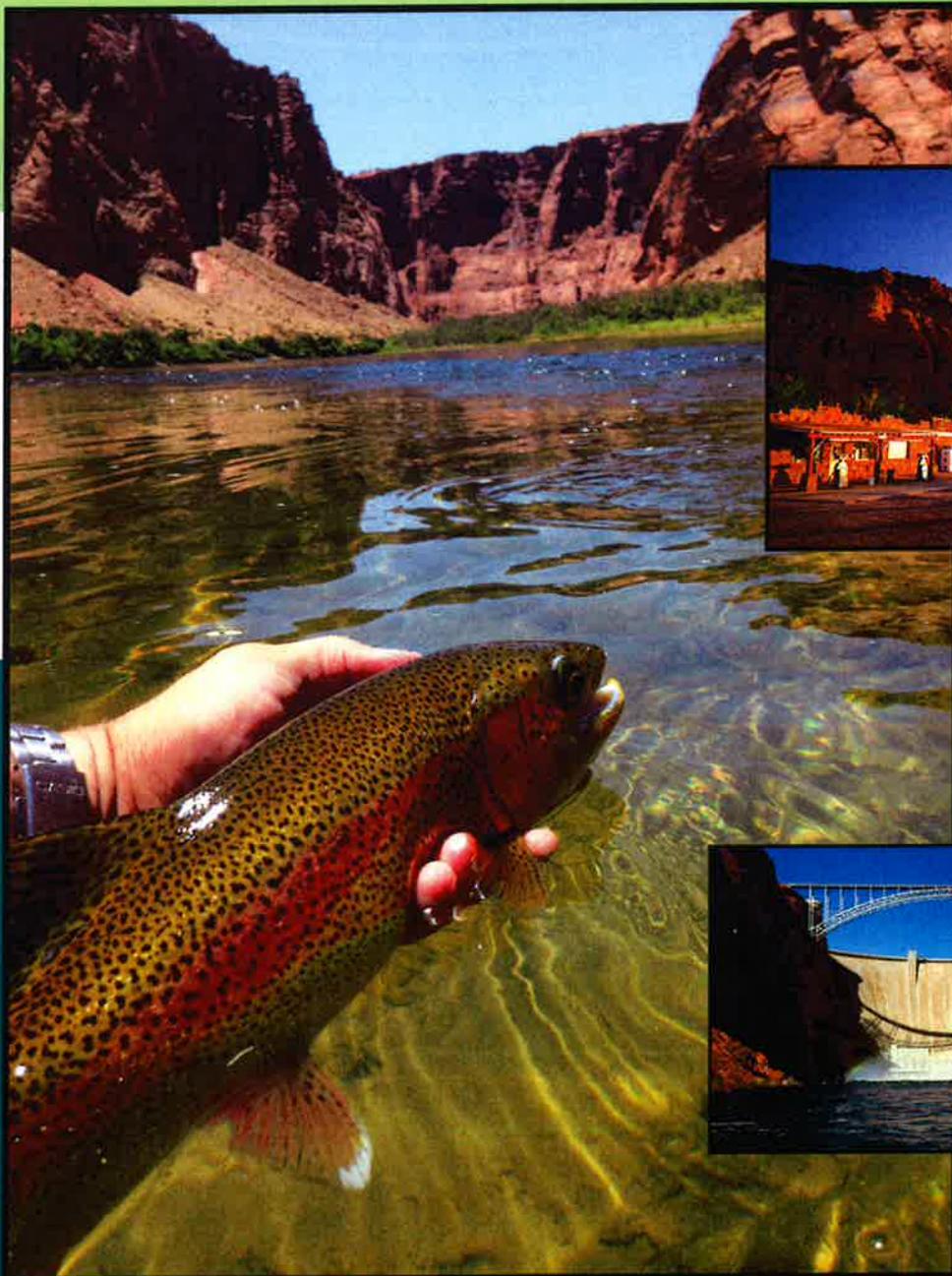
1. Maintain and enhance a wild (self-sustaining) blue ribbon rainbow trout fishery at Lees Ferry that does not adversely affect the native aquatic community in Grand Canyon National Park
2. Provide a dependable, high-quality recreational trout fishery that sustains economic support for local businesses and Coconino County.

Major Recommendations:

1. **Aquatic Food Base Enhancement.** Establish a more productive, diverse and stable food base that includes bigger bugs like mayflies, stone flies, and caddis flies which are currently absent in the Lee Ferry reach. A more diverse food base would not only benefit rainbow trout size and condition but also may benefit native fish and the riparian bird community downstream in Grand Canyon National Park. One strategy for enhancing the food base involves experimentally altering flow regimes from the dam to allow for repatriation by may-, stone-, and caddis flies.
2. **Spring high flows.** Place more emphasis on conducting high flow releases in the spring as a way to improve the aquatic food base and enhance trout spawning and recruitment, when needed. The March 2008 high flow had that effect whereas the fall high flows over the past 3 years have had a neutral or negative effect on the food base and trout recruitment.
3. **Trout Management Flows.** Test trout management flows as a means to control the density of young trout in the reach and reduce downstream migration of trout where they compete with and/or prey upon native fish like the endangered humpback chub.
4. **Dam operations** In general, maintain the current release patterns from Glen Canyon dam which provides relatively low daily fluctuations that are adjusted monthly based on water availability and water delivery requirements to Lake Mead. Some modification of the current flow regime may be needed to support the establishment of a more diverse and stable food base.
5. **Minimum flows.** Avoid minimum flows below 8000 cfs whenever possible.
6. **Water Temperature Control Device.** Implement a water temperature control device that has the capacity to release both cold and warm water from the Glen Canyon Dam. Recently studies suggest that amount of water in Lake Powell will likely decrease in the future as a result of increased water demands and climate change. Lower Lake Powell level will lead to warmer water release from dam which would seriously impact the Lees Ferry trout fishery and lead to an invasions of cool and warm water fishes into Grand Canyons National Park.
7. **Emergency Re-Stocking Protocol.** Re-stocking protocols and the necessary environmental compliance should be in place to respond to catastrophic loss that would at least minimally restore the fishery in the near term.
8. **Dissolved Oxygen Response Protocol.** Rarely, but on occasion, situations have emerged where water quality below Glen Canyon Dam was threatened because of a lens of poorly-oxygenated water passing through the reservoir. These conditions can pose a direct and immediate hazard to aquatic resources in Lees Ferry. Action strategies are needed to reduce or avoid the potential effects to aquatic resources when these conditions emerge.

LEES FERRY RECREATIONAL TROUT FISHERY MANAGEMENT RECOMMENDATIONS:

The Voice of Lees Ferry Recreational Anglers, Guides, and Businesses

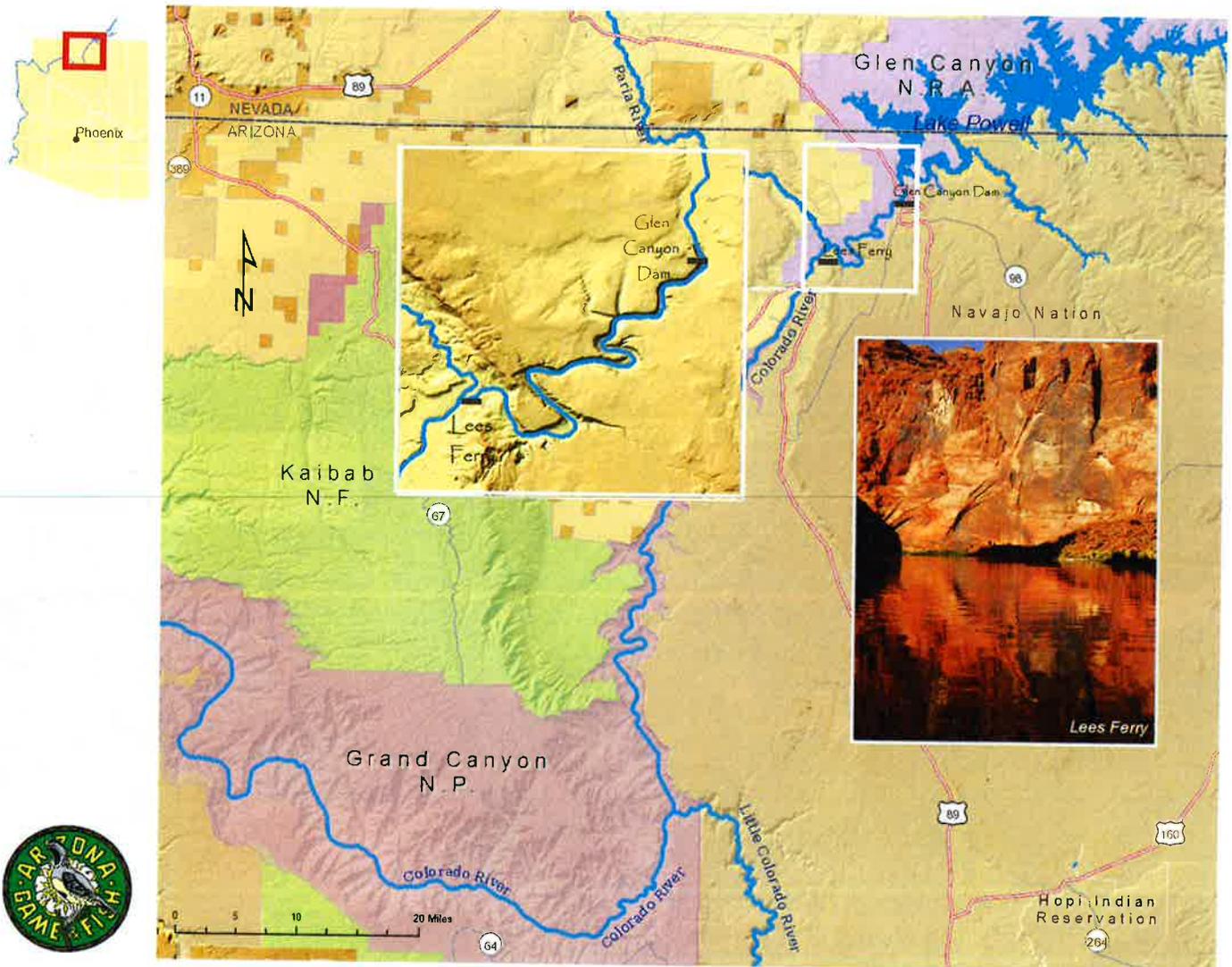


August 2015

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Executive Summary: Lees Ferry Recreational Trout Fishery Recommendations

The 15.5-mile stretch of Colorado River winding through Glen Canyon between the Glen Canyon Dam and the beginning of Marble Canyon (within Grand Canyon National Park) is commonly referred to as Lees Ferry. Since 1964, with the completion of the Glen Canyon Dam, this unique tailwater has hosted a recreational trout fishery that has grown in importance and reputation locally, regionally, nationally, and internationally. This blue ribbon recreational sport fishery has also become a financial and economic mainstay for the small community of Marble Canyon and Coconino County, supporting fishing guide services, hotels, restaurants, fishing and outdoor recreation equipment and supplies, and visitor services.

A primary purpose of the Lees Ferry Recreational Fisheries Management Recommendations is to complement and augment the National Park Service's 2014 Comprehensive Fisheries Management Plan for the Colorado River below Glen Canyon Dam. Additionally, the recommendations are provided to inform decisions about future management of Glen Canyon Dam and the blue ribbon rainbow trout fishery in Glen Canyon National Recreation Area. Another key purpose is to help shape alternatives in the Glen Canyon Dam Long Term Experimental and Management Plan Environmental Impact Statement.

These recommendations are intended to:

- Maintain and enhance a wild (self-sustaining) blue ribbon rainbow trout fishery at Lees Ferry that does not adversely affect the native aquatic community in Grand Canyon National Park.
- Provide a dependable, high-quality recreational trout fishery that sustains local businesses and the economy of Coconino County.

Currently, the Lees Ferry trout fishery is ecologically unstable due to an impaired aquatic food base and high levels of trout recruitment that results in a population that exceeds the carrying capacity of the river. Specific management recommendations are provided for:

- Establishing a more diverse aquatic food base by repatriating the Lees Ferry reach with native aquatic invertebrates.
- Continuing the current modified low-fluctuating flow regime with adjustments to develop a more diverse aquatic food base.
- Conducting spring and fall high flow experiments to restore more natural flow regimes to the river, enhance the aquatic food base, and improve trout survival/recruitment when needed.
- Carefully testing trout management flows to help achieve desired trout recruitment and abundance targets.
- Developing an action plan to respond to low dissolved oxygen conditions that are lethal to rainbow trout in Lees Ferry.
- Assessing the feasibility of adjusting Lake Powell-Lake Mead equalization guidelines to better manage trout survival and recruitment.
- Enacting fishing regulations to provide for a quality fishery and help manage the Lees Ferry trout population.
- Exploring ways for tribal members, local guides, and recreational anglers to harvest rainbow trout in Marble Canyon as a means of reducing downstream emigration of rainbow trout, and enhancing recreational use and employment and business opportunities in the local community.
- Restocking rainbow trout in Lee Ferry in the event of a catastrophic loss of the fishery.
- Implementing a water temperature control device at Glen Canyon Dam to maintain a water temperature regime that will support both a healthy trout and native fish population in Lees Ferry and downriver.
- Introducing turbidity at the confluence of the Paria and Colorado rivers as a means of controlling trout populations below the Paria River.
- Evaluating the feasibility of making structural modifications to the bypass tubes at Glen Canyon Dam to allow for water temperature regulation, mitigation of low DO levels, and electrical generation when the bypass tubes are in use.
- Conducting long-term resource monitoring to support adaptive management and to measure progress toward achieving goals and desired future condition

The Recommendations are consistent with and will benefit many other Colorado River resource values below Glen Canyon Dam including humpback chub recovery, sand conservation, hydropower generation, and cultural resource protection.



Photo: George Andrejko

The Lees Ferry Trout Fishery

Anglers from around the world travel to Lees Ferry to fish for high quality rainbow trout in the large, clear, swift-flowing Colorado River as it winds its way through the lower, scenic segment of Glen Canyon. This Lees Ferry recreational fishery has become a financial and economic mainstay for the small community of Marble Canyon, the city of Page to the north, and Coconino County. A 2013 statewide angler survey estimated the contribution of the Lees Ferry fishery to the State's economy in excess of \$16.8 million, helping to support 251 jobs in Arizona (Fedler 2014). Anglers support local businesses such as hotels, restaurants and other service providers, in addition to utilizing fishing and outdoor recreation equipment suppliers and guides.

Because of the reliable flows of cold water ranging from 44 to 60 degrees F, the Lees Ferry reach of the Colorado River has a proven capacity to support a remarkable trout fishery in a desert environment. The fishery itself has changed significantly since it was first created following the completion of the Glen Canyon Dam in 1964. During its infancy, the fishery produced huge rainbow trout ranging from 10 to 20 pounds. Since then the fishery has gone through peaks and valleys, but throughout its history has provided some of the most sought-after destination trout fishing opportunities in the Southwest.

Rainbow trout are the primary sport fish targeted by anglers at Lees Ferry. By agreement with the land and water managers, the Arizona Game and Fish Department (AZGFD) initiated regular stocking of trout of the Lees Ferry reach in 1964. The sport fishery was maintained through stocking catchable and later fingerling—rainbow trout from 1964 through the mid-1990s. Natural reproduction of rainbow trout became more substantial and self-sustaining in the early 1990s with the establishment of more stable flows as a result of the re-operation of Glen Canyon Dam. Stocking ceased in 1998 when it became clear that natural reproduction and recruitment of the trout population was meeting angler demands.

After nearly two decades of success, anglers and the local community at Marble Canyon consider the Lees Ferry recreational fishery a highly valued resource on par with other values when it comes to making decisions about Glen Canyon Dam operations and experiments.

In 2014, anglers spent more than 10,000 fishing days at Lees Ferry (Rogowski et al. 2014 citation in prep). In recent years, angler use of the Lees Ferry fishery has declined, and the fishery currently falls

Land, water, and wildlife resources in the Colorado River Corridor in Glen Canyon are managed by multiple authorities.

USBR – The US Bureau of Reclamation manages water and dam operations, in concert with Western Area Power Administration, for hydroelectric generation.

NPS – The National Park Service manages the lands and compatible uses on the land, including wildlife resources in Glen Canyon National Recreation Area and Grand Canyon National Park.

USFWS – The US Fish and Wildlife Service manages threatened and endangered species, including the endangered humpback chub. USFWS and AZGFD have a joint responsibility to advise USBR on the effects of water projects on all wildlife.

AZGFD – Arizona Game and Fish Department is the primary management agency for resident fish and wildlife in the State of Arizona.

AMWG – The Adaptive Management Working Group is a Federal Advisory Committee formed as a result of the 1996 EIS. They advise the Secretary of the Department of Interior on matters related to the operations of Glen Canyon Dam.

far short of its potential to generate angling recreation and economic wellbeing in northern Arizona.

Purpose and Need

This report and recommendations were developed collaboratively among recreational anglers based on the best available science in consultation with the Arizona Game and Fish Department (AZGFD) and the U.S. Geological Survey (USGS) Grand Canyon Monitoring and Research Center (GCMRC). The recommendations are intended to complement and augment the National Park Service's (NPS) 2014 Comprehensive Fisheries Management Plan and help achieve the desired future conditions established by the Glen Canyon Dam Adaptive Management Work Group (AMWG), and approved by the Secretary of the Interior (Appendix A). Additionally, the Recommendations are provided for the consideration of the Arizona Game and Fish Commission, Bureau of Reclamation, NPS, the US Fish and Wildlife Service, Western Area and Power Administration, and Department of Interior to inform decisions about future management of Glen Canyon Dam and the blue ribbon rainbow trout fishery. Another key purpose is to help shape alternatives in the Long Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS).

These Recommendations will be modified periodically based on new information and used to inform future Colorado River planning processes and guide decisions related to management of the Lees Ferry trout fishery and operations of Glen Canyon Dam.

Goals and Objectives

Our goals and objectives are based on the best available scientific information gathered through the Glen Canyon Dam Adaptive Management Program (GCDAMP), the Desired Future Conditions that were adopted by the AMWG and the Secretary of the Interior, the CFMP, and the mandate of the Grand Canyon Protection Act to operate Glen Canyon Dam to improve the values for which Glen Canyon National Recreation Area was established.

1. Maintain and enhance a wild (self-sustaining) blue ribbon¹ rainbow trout fishery in Lees Ferry, without adversely affecting the native and endangered fish community in Grand Canyon National Park. Key objectives or targets that define a wild (self-sustaining) blue ribbon rainbow trout recreational fishery include:

- A size structure indicative of a stable rainbow trout population (on an annual basis 20-50 percent of the population will be less than 6 inches in length).
- An angler catch rate of at least 1 trout/hour \geq 14 inches in length.
- An angler catch rate of at least 0.1 trout/hour \geq 20 inches in length.
- A robust body condition factor (K_n) for adult rainbow trout of ≥ 1.0 in the summer.
- A diverse aquatic food base with 10% of the abundance comprised of mayflies, stoneflies and caddis flies.

2. Provide a dependable, high-quality recreational trout fishery that sustains local businesses and the economy of Coconino County.

- Regain angler use levels \geq 20,000 angler days per year
- Explore ways for tribal members, local guides, and recreational anglers to harvest rainbow trout in Marble Canyon as a means of reducing downstream emigration of rainbow trout, and enhancing recreational use and employment and business opportunities in the local community.

¹ A **Blue Ribbon fishery** is a designation that identifies recreational fisheries of extremely high quality. *Blue Ribbon* status is based on a set of established criteria which typically addresses the following elements:

- o *Water quality and quantity:* A body of water that has sufficient water quality and quantity to sustain a viable fishery.
- o *Water accessibility:* The water is accessible to the public.
- o *Natural reproduction capacity:* The body of water possesses a natural capacity to produce and maintain a sustainable recreational fishery. There must be management strategies that will consistently produce fish of significant size and/or numbers to provide a quality angling experience.
- o *Angling pressure:* The water must be able to withstand angling pressure.

Arizona Game and Fish Department is currently developing a specific definition for Arizona.

Key Federal Laws and the Glen Canyon Dam Adaptive Management Program

Glen Canyon Dam was constructed pursuant to the **Colorado River Storage Project Act** of 1956 (CRSPA) which provided for the reclamation of arid and semiarid land, the control of floods and the generation of hydroelectric power. Modification of Colorado River flows due to the construction and operation of Glen Canyon Dam has impacted fish, wildlife and their habitats through reduction or elimination of overbank flooding, channelization, water depletions and water quality. Mitigation for these impacts is authorized through CRSPA.

The **Grand Canyon Protection Act** (GCPA) of 1992 directed the Secretary of the Interior to operate Glen Canyon Dam and exercise other authorities “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.” The GCPA also specifies that it should be implemented consistent with various laws that govern water allocation and development in the Colorado River.

The **Endangered Species Act** of 1973 prohibits Federal agencies from taking actions that are likely to jeopardize the continued existence of threatened and endangered species. The impacts of GCD operations on the endangered humpback chub is a significant consideration.

The **Glen Canyon Dam Adaptive Management Program** (GCDAMP) was established in 1997, under the direction of the Secretary of the Interior, in compliance with the GCPA and the 1996 Record of Decision. The GCDAMP provides for adapting the dam’s operations to facilitate management actions, scientific research, and monitoring consistent with the purposes for which the dam was constructed.

Recommended Actions to Meet Management Goals and Objectives

Aquatic Food Base Enhancement through Experimental Repatriation and “Bug Flows”

The current aquatic food base in Lees Ferry is insufficient to sustain a quality trout fishery, being composed of few varieties of invertebrates, all of which are small in size. The abundance and size composition of the available food items for trout, when viewed in the context of anatomical realities of how trout collect their food, limits their ability to grow to preferred sizes (Mike Dodrill, USGS 2015, annual reporting meeting). The availability of energy-rich food items in the right size assortments influences the ability of trout to grow both in length and in girth (condition).



Ephemeroptera, Plecoptera, Tricoptera (EPT) are three orders of aquatic insects commonly referred to as mayflies, stone flies and caddis flies. The EPT Index is a widely accepted measure of stream quality based upon the abundance of these aquatic insects, premised on the

understanding that the most productive and resilient aquatic ecosystems have the highest diversity of species in these three orders (Lenat and Penrose, 1996). The EPT index is particularly well suited for evaluating the aquatic food base of primarily insectivorous fishes like rainbow trout and humpback chub.

Assemblages of EPT, which are present in every other tailwater fishery in the west and are found upstream of Lake Powell and in tributaries in the Grand Canyon, are totally absent below the Glen Canyon Dam. A study is included in GCDAMP FY 2015-2017 Triennial Budget and Work Plan to test whether daily fluctuating releases may be influencing the availability and abundance of EPT in the Colorado River below Glen Canyon Dam (USGS and BOR 2014). We strongly support this study including the testing of the so called “bug flows” as a means for establishing a healthy and robust EPT population (USGS and BOR 2014). Recommended experimental “bug flows” involve stable flows every weekend from May through August. The discharge on weekends would be the minimum discharge for that month to ensure that the insect eggs laid during weekends would not be subjected to drying due to lower water levels at any point prior to larval development. No change in monthly volumes, ramping rates, or the daily range in discharge during weekdays would be required as part of this experiment. To offset the smaller water releases that would occur during weekends within a given month, larger releases would need to occur during the weekdays within a given month.

Consistent with National Park Service policy that the recovery and restoration of extirpated species is a desired goal, we also strongly recommend the translocation of historic EPT species from other parts of the Colorado River drainage into the Lees Ferry reach coincidental with the experimental flows discussed above. A series of experimental translocations to repatriate these native species should be initiated, followed by monitoring and evaluation of success and sustainability.

Dam Operations

In general, we recommend a continuation of the current Modified Low Fluctuating Flow (MLFF) regime. The MLFF regime provides relatively low daily fluctuations that are adjusted monthly based on water availability, electrical energy demands and water delivery requirements to Lake Mead. However, some modification of the MLFF regime is needed to determine whether a more steady flow regime will promote the establishment of a more diverse and stable aquatic food base (see above).

Minimum Flows

As a general rule, the minimum release from Glen Canyon Dam should be 8,000 cfs other than for exceptional events when the minimum could be reduced by 1000 cfs for short periods of time during night time. Exceptional events include pre and post High Flow Experiments or years when releases from Lake Powell are significantly lower than normal. We are concerned that lower water releases in combination with daily fluctuations will result in reduced nearshore habitats which are important for survival of young of year fish and aquatic invertebrates. Low flows also create navigation problems and safety concerns for boaters and fishermen. Ongoing studies to establish a more science based minimum flow should be continued.

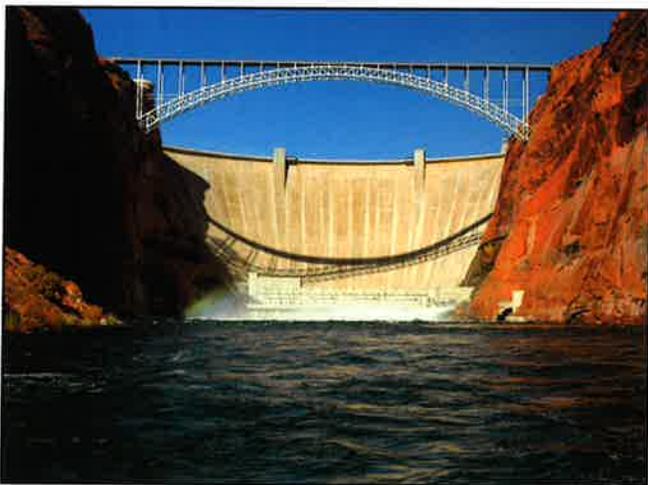
Fall and Spring High Flow Experiments (HFEs)

High flow Experiments (HFEs) are controlled water releases from Glen Canyon Dam that are designed to mimic natural pre-dam seasonal flooding. The primary objective of these releases is to rebuild sand bars that provide habitat for native plants and animals, rebuild camping beaches for river runners, and provide a source of fine sediments that protect archaeological sites from weathering and erosion. The 2008 spring high flow enhanced recruitment and survival of young rainbow trout, and enhanced the aquatic food base (Korman et al. 2011; Kennedy and Ralston 2011). Because of concerns about rainbow trout impacts on the endangered humpback chub, recent HFEs have been restricted to the fall to help manage rainbow trout recruitment and survival.

In general, we support implementation of fall high flows consistent with the 2012 Environmental Assessment (USBR, 2012) and as part of an experimental design to further evaluate trout response in both Lees Ferry and Marble Canyon, as well as food base and other resources. However, we believe that additional spring HFE's are needed to assess the food base and trout response that was observed in 2008. We also recommend that more emphasis be placed on conducting HFE's in the spring as a management option for use when there has been a significant decline in the trout population and/or drop in food production. We believe that spring high flows will provide other resource benefits such as helping to control nonnative mud snails and build camping

beaches in Marble and Grand canyons immediately before the peak rafting season. Spring HFE's will also provide a source of fine sediment just prior to the windy season in the Grand Canyon that will help protect archeological sites from weathering and erosion. Finally, spring floods, which historically occurred on a regular basis in the Grand Canyon, will help re-establish natural ecological processes in the Colorado River below Glen Canyon Dam

Triggers for spring high flows should be identified based on trout recruitment, and adult trout population and aquatic food production, in addition to down river sediment conservation needs. A spring HFE could be used in lieu of or in conjunction with trout stocking when the trout fishery has experienced a significant decline.



Experimental Trout Management Flows

Under certain conditions, rainbow trout at Lees Ferry have reproduced prolifically. Historically, when there is an over-abundance of young-of-year rainbow trout, the quality and condition of rainbow trout decline. This is likely due to the low quality and low abundance of food sources in Lees Ferry. Trout Management Flows (TMFs) are flow treatments that are hypothesized to reduce the abundance of young-of-year trout by stranding

trout shortly after they emerge from their redds (Korman, Ecometric Research, Inc., personal communications, 2015). We believe the best long term and ecologically appropriate solution to controlling trout densities is to increase invertebrate diversity and manage Grand Canyon Dam flows to avoid excessive trout spawning and recruitment (see recommendations related to the aquatic food base and equalization flows). We are concerned about the collateral damage that TMFs could have on other resources especially the aquatic food base and native fish. TMFs may be especially useful when spring HFE's are implemented or in years when high equalization flows are required.

TMF's should only be implemented in a carefully designed experimental framework that includes quantified criteria for success (for managing trout recruitment and improving the humpback chub population) and the impacts to other resources, especially the aquatic food base, are fully assessed. TMF's should only be used when the rainbow trout population is stable and includes a healthy abundance of all size classes of rainbow trout. Mitigation measures such as emergency stocking of trout need to be in place prior to the implementation of TMFs in case of catastrophic loss to the fishery (see recommendations on Trout Stocking). In conclusion, the experimental evaluation of TMFs needs to recognize the trout fishery as a highly valued asset. The AZGFD should have a seat at the table along with Federal agencies on any discussion and decisions related to implementation of TMFs.

Equalization Flows

The impact of sustained periods of high flows that are designed to equalize water storage in Lake Powell and Lake Mead can result in undesirably high trout recruitment in the Lees Ferry reach. For example, the high equalization flows in 2011 are correlated with a large recruitment of trout that cannot be sustained under normal release volumes. While outside the scope of the current LTEMP EIS, we believe that the current equalization guidelines should be revisited to provide greater flexibility in meeting annual delivery requirements from Lake Powell to Lake Mead. For example, greater flexibility in making water deliveries outside of the water year would increase the flexibility to manage Glen Canyon Dam releases consistent with the desired future conditions for sand conservation and the Lees Ferry rainbow trout fishery.

Fishing Regulations

Historically, harvest regulations were the only tools available for managing the Lees Ferry trout population. The Arizona Game and Fish Commission should adjust harvest regulations as needed to achieve the desired quality and numbers of fish in the Lees Ferry trout population. Consideration should be given to encouraging the public to harvest trout especially when the rainbow trout population has exceeded the carrying capacity of the river. Public education and outreach campaigns will be necessary to encourage anglers to embrace new harvest regulations and trout population management goals.

Marble Canyon Trout Fishery

Rainbow trout numbers downstream of Lees Ferry in Marble Canyon can at times approach or even exceed those in the Lees Ferry reach. The CFMP provides for using angling to remove trout in Marble Canyon as a mean of reducing competition between rainbow trout and native warm water fish. The Marble Canyon trout population also provides an opportunity to use a presently underutilized recreational fishing resource to grow local businesses and employment. We recommend that the NPS and the AZGFD explore ways for tribal members, local guides, and recreational anglers to harvest rainbow trout in Marble Canyon as a means of reducing downstream emigration of rainbow trout, and enhancing recreational use and employment and business opportunities in the local community.

Riparian Vegetation Restoration

Restoration of riparian vegetation in the Lees Ferry reach should be a high priority of the NPS. In addition, the feasibility of using dead tamarisk as fish habitat to improve aquatic productivity in the Lees Ferry reach should be investigated. Riparian vegetation plays an important role in supporting terrestrial insect abundance (trout food source), and providing overhanging shade and cover for fish.

Stocking in the Event of a Catastrophic Fishery Failure

Sequential annual losses of young-of-year recruits to the population would have severe consequences on future catch rates, angler satisfaction, and the local economy. To respond to this possibility, the CFMP includes the provision to stock sterile rainbow trout in the event of a significant decline in trout abundance and fishermen catch rates over a period of several years. However, as discussed below, there is also the possibility of a catastrophic failure of the fishery resulting from low dissolved oxygen levels or high water temperatures. In these events, stocking should be utilized to restore the trout fishery as soon as the factors that caused the catastrophic failure have been identified and ameliorated. Given that the goal of these Recommendations is to maintain a wild, self-sustaining trout fishery, we recommend that restocking should occur using the progeny of wild trout currently found in the Colorado River below Glen Canyon Dam. We believe that wild trout currently found in Lee Ferry are well adapted to survive and provide a quality fishery consistent with the Blue Ribbon standard. A sufficient number of wild trout should be collected for use as brood stock if it appears that a collapse of the fishery is imminent. If this is not feasible, we recommend securing a high quality strain of rainbow trout from reputable commercial and governmental sources. Additionally when stocking is deemed appropriate, management agencies should consider translocation of wild rainbow trout from downstream of the Paria River to supplement the trout population within the Lees Ferry reach. Translocation could help achieve multiple goals by enhancing Lees Ferry sportfish opportunities and reducing down river migration of trout.

A contingency stocking plan should be developed and made ready by AZGFD with necessary environmental compliance so that an immediate response to stocking triggers or catastrophic failure of the trout fishery can be implemented in a timely manner.

Low Dissolved Oxygen Response Protocol

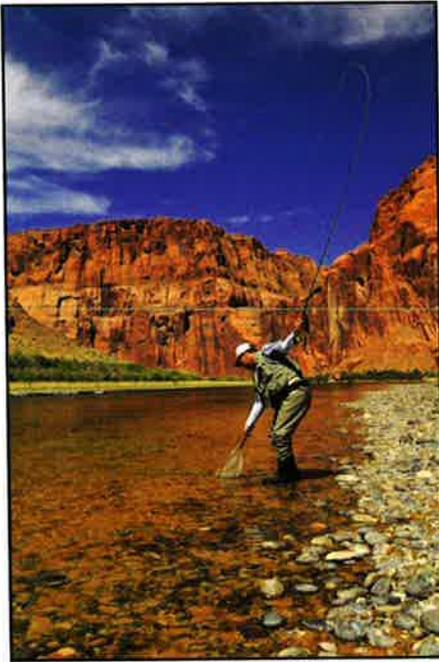
The availability of oxygen in the water released from the dam is directly influenced by the oxygen profile of Lake Powell. That profile is affected by complex processes, including cold runoff input events rich in organic materials that occur far upstream of the dam, which can create mid-depth sags in oxygen levels. Poorly oxygenated water, if discharged through the dam, can severely stress fish in the tailwater, resulting in reduced growth and even mass mortality.

Fish kills in the Lee Ferry reach have been documented in 2005 due to the low dissolved oxygen (DO) levels. In 2014, dissolved oxygen levels dangerously approached the lethal limit for trout. The combined effect of low dissolved oxygen, high water temperatures, and low food production pose a direct and immediate hazard to rainbow trout and other fish species in Lees Ferry. USBR and GCMRC should closely monitor DO levels in Lake Powell and in the Colorado River and provide alerts when DO levels are expected to approach dangerous levels below Glen Canyon Dam. USBR should immediately develop an action plan to reduce or avoid the potential effects to aquatic resources when these conditions emerge. In addition, dissolved oxygen levels should be made publically available at Glen Canyon Dam in addition to at the Lees Ferry gage.

Temperature Control Device

Water temperatures are a primary driver for the well-being and health of native and non-native fish communities in Glen, Marble and Grand Canyon, yet currently there is no capability to affect release temperatures from Glen Canyon Dam. The recently completed USBR Water Supply and Demand Study for the Colorado River Basin suggests that Lake Powell elevations will likely decrease in the future as a result of increased water demands, drought, and climate change. Lower Lake Powell elevations will lead to warmer water release from Glen Canyon Dam, which could lead to invasions of warm water fishes and other invasive species into the Marble and Grand canyons. There is clear evidence from the upper Colorado River basin that such an invasion would have a devastating impact on humpback chub and other native fishes in the Colorado River below Glen Canyon Dam (Tyus and Saunders 2000).

The Bureau of Reclamation (USBR) should immediately move forward with implementing a Temperature Control Device that has the capacity to release both cold and warm water from the dam as recommended by the GCDAMP Science Advisors (Gunderson et al. 2003) and reaffirmed in a 2008 expert panel review (GCMRC, 2008).



Bypass Tube Electrical Generation

USBR should also consider making structural modifications to the outlet works at Glen Canyon Dam to allow for the generation of electricity when the bypass tubes are in use for HFEs or to address water quality (low dissolved oxygen and high water temperature) emergencies in the Lees Ferry reach. Having the ability to release water below the current penstock may be the only way to cool the river when warm releases occur and instantly mitigate low DO releases from the dam. This strategy could also mitigate for loss in power revenue during times of emergency response or during their utilization for HFEs.

Introduce Turbidity

It is well established that rainbow trout significantly reduce feeding activity when water clarity is low. Runge et al (2011) identified the strategy of a “turbidity curtain” (providing inputs of fine sediment below the Paria River) as the highest priority mitigation option for controlling rainbow trout in Marble Canyon. Introducing turbidity into the Colorado River below the Paria River would minimize the need for mechanical removal near the Little Colorado River. We recommend investigating the possibility of reducing water clarity below the Paria River by artificially suspending sediment in that drainage and increasing turbidity in the main stem.

Monitoring and Measurement of Management Triggers

Long-term resource monitoring is the key to effective adaptive management (Walters and Holling 1990). AZGFD has been conducting standardized electrofishing surveys of the Lees Ferry fish population since 1991. Electrofishing surveys currently occur in spring, summer and fall and provide valuable information on relative abundance, population structure, recruitment, and condition of the entire fish community in Lees Ferry. In addition, AZGFD has been conducting a creel survey since 1964 that has provided valuable information that is currently used to address many of the concerns of the angling community, particularly as it relates to angler catch, angler satisfaction, harvest rates, and the economic impacts of the fishery. The GCMRC has an established water food base monitoring program for the Lees Ferry reach (Carlisle et al 2012). It is important to continue all these programs and to provide timely reporting of findings and conditions related to the Lee’s Ferry fishery.

Additionally a surveillance plan for other aquatic invasive species (e.g., quagga mussels, crayfish, and whirling disease) that may harm the fishery should be fully developed. The existing monitoring programs have the ability to detect invasive species, but need to be expanded and coordinated to improve early detection and to report findings rapidly and consistently.

In addition, flows, temperature, dissolved oxygen, and nutrient levels should continue to be monitored below Glen Canyon Dam. Conditions in Lake Powell that may potentially lead to releases of low DO should be monitored and reported in a timely fashion. Channel geomorphology (mapping) and riparian habitat in the Lees Ferry reach should be monitored on a periodic basis.

We recommend that Lees Ferry monitoring programs and proposed management actions should be a major focus of the Protocol Evaluation Panel (PEP) review of the GCDAMP fishery program in late 2015 or early 2016. The Panel should be requested to provide recommendations on:



Photo: Arizona Game and Fish Department

1. Approaches to identify the root cause(s) of the unstable trout populations in Lees Ferry;
2. The highest priority actions to stabilize and enhance the quality of the aquatic food base and the Lees Ferry trout fishery;
3. The appropriate metrics to trigger TMF's, stocking, and other management actions;
4. The most appropriate methods and level of effort to effectively monitor progress towards achieving the goals outlined in this report;
5. Important data gaps that need to be filled and uncertainties that need to be resolved; and
6. The need to develop a Stock Assessment Model to:
 - a. measure progress towards reaching the goals contained in this report,
 - b. determine the suitability of the metrics identified in the report, and
 - c. evaluate the effectiveness of increasing harvest as a tool for managing the trout fishery.

A synthesis of available fish, food base, flow, and water quality data for the period of 2003-2014 should precede the PEP review. This period includes warming water temperature, spring and fall HFEs, winter TMF's, periods of low DO, equalization flows, and several steady flow tests. To facilitate a productive PEP review, we recommend that a technical workshop should be held prior to the PEP review to summarize the available data for the panel.

Summary and Conclusions

Currently, the Lees Ferry trout fishery is ecologically unstable due to an impaired aquatic food base and high levels of trout recruitment that results in a population that exceeds the carrying capacity of the river. The food base in the Colorado River below Glen Canyon Dam consists of only a few varieties of invertebrates. Assemblages of native may flies, caddis flies and stone flies which are present in every other tailwater fishery in the west and are found upstream of Lake Powell and in tributaries in the Grand Canyon are totally absent below the dam. Our highest priority recommendation is to pursue establishment of a more diverse aquatic food base by testing alternative flow regimes in conjunction with repatriating the Lees Ferry Reach with native aquatic invertebrates including may-, caddis-, and stone-flies.



We also recognize that over recruitment of young rainbow trout is a major factor that contributes to the instability of the fishery. We believe the best long term and most ecologically appropriate solution to controlling trout densities is to increase invertebrate diversity and manage Glen Canyon Dam flows to avoid excessive trout spawning and recruitment (e.g., adjusting Lake Powell-Lake Mead equalization guidelines to avoid unsustainable trout recruitment). However, under certain situations, trout management flows (TMFs) may be a useful tool to help achieve desired trout recruitment and abundance targets, especially when spring HFE's are implemented or high equalization flows are required. TMFs are untested and we are concerned about collateral damage to other resources especially the aquatic food base which could further destabilize and impact the quality of the trout fishery. As such, the experimental evaluation of TMFs needs to recognize the trout fishery as a highly valued asset and should be used only when recommended criteria are met and measurable criteria for success have been identified.

We believe the biggest long term threat to the trout fishery and the native Colorado River fishes is increased water temperature associated with a lower Lake Powell. The Colorado River Basin is in the midst of a 10 year drought and climate studies suggest significantly reduced water supplies in the future. One of the consequences will be the water temperatures below Glen Canyon Dam will turn much warmer which will have catastrophic consequences for the Lees Ferry trout fishery and native fish down river. We recommend implementing a water temperature control device at Glen Canyon Dam to maintain water temperature regimes that will support a healthy trout and native fish population in Lees Ferry and downriver.

We are also concerned about low dissolved oxygen (DO) levels in the water releases from Glen Canyon Dam. The availability of oxygen in the water released from the dam is directly influenced by the oxygen profile of Lake Powell. Poorly oxygenated water, if discharged through the dam, can severely stress fish in the tailwater, resulting in reduced growth and even mass mortality. An action plan should be developed by the Bureau of Reclamation to reduce or avoid the potential effects to aquatic resources when/if low DO conditions emerge. We further recommend an evaluation of the feasibility of making structural modifications to the bypass tubes at Glen Canyon Dam to allow for water temperature regulation, mitigation of low DO levels, and electrical generation when the bypass tubes are in use.

These recommendations were developed in full consideration of other natural and cultural resources in the Colorado River below Glen Canyon Dam. We believe that a healthy blue ribbon trout fishery is compatible with healthy native fish populations downstream and that the recommendations in this report will benefit native fish and many other Colorado River resource values below Glen Canyon Dam, including:

- A more diverse aquatic food base will benefit the native fish community (including humpback chub) and riparian species throughout Glen, Marble and Grand canyons.
- Spring and fall HFE's and adjustments to Lake Powell-Lake Mead equalization guidelines will benefit sand conservation, beach building, and archaeological site protection.
- Trout management flows and a TCD will benefit the native fish community and humpback chub recovery.
- A continuation of the MLFF regime will benefit hydropower production. The native fish community, including the humpback chub, have also done well under the MLFF regime.
- Providing for electrical generation on the bypass tubes will benefit hydropower production.
- Proactive management of the Lees Ferry trout fishery will reduce downstream trout migration, avoid massive trout die-offs, and minimize the need for using lethal means to control trout populations near the Little Colorado River.

The voice of Lees Ferry anglers, guides, and businesses are fully united in their support of these Recommendations. Our sincere hope and expectation is that the Recommendations will be given full consideration by the GCDAMP, and the Federal and State agencies responsible for managing the Colorado River resources below Glen Canyon Dam.

Literature Cited

- Bradford, M., Bevelhimer, M., Hansen, M., Mueller, G., Osmundson, D., Rice, J., & Winkelman, D. (2009). Report of the 2009 Protocol Evaluation Panel for Fish Monitoring Programs of the Grand Canyon Monitoring and Research Center.
- Carlisle, D., Gutreuter, S., Holdren, G. C., Roberts, B., & Robinson, C. (2012). Final Report of the Aquatic Food Base Study and Protocol Evaluation Panel.
- Fedler, A.J. 2014. 2013 Economic Impact of Fishing in Arizona. Technical Report for the Arizona Game and Fish Department, pp. 14.
- Grand Canyon Monitoring and Research Center, 2008, USGS workshop on scientific aspects of a long-term experimental plan for Glen Canyon Dam, April 10–11, 2007, Flagstaff, Arizona: U.S. Geological Survey Open-File Report 2008–1153, 79 p.
- Gunderson, L., Howard, A., Hulse, D., Kitchell, J., Loomis, J., Palmer, M., .,m & Schwartz, U. D. (2003). Evaluating A Glen Canyon Dam Temperature Control Device To Enhance Native Fish Habitat In The Colorado River: A Risk Assessment By Adaptive Management Program Science Advisors.
- Kennedy TA, Ralston BE. 2011. Biological responses to high-flow experiments from Glen Canyon Dam. In: Effects of Three High-Flow Experiments on the Colorado River Ecosystem Downstream. From: Glen Canyon Dam, Arizona, Melis TS (ed). US Geological Survey Circular: 2011-1366: Reston, VA; 93–125.
- Korman, J.,M. Kaplinski, and T. S.Melis. 2011. Effects of fluctuating flows and a controlled flood on incubation success and early survival rates and growth of age-0 rainbow trout in a large regulated river. Transactions of the American Fisheries Society 140:487–505.
- Lenat, D.R., and Penrose. D.L.. 1996. History of the EPT taxa richness metric: Bulletin of the North American Benthological Society, v. 13, no. 2, p. 305-307.
- McKinney, T. and W. R. Persons. 1998. Lee's Ferry rainbow trout fishery--an ecological synthesis. Final Report to Grand Canyon Monitoring and Research Center. Arizona Game and Fish Department, Phoenix.
- Rogowski D.L., L.K. Winters, P.N. Wolters, and K.M. Manuell. 2014. Status of the Lees Ferry trout fishery. 2014 Annual Report prepared by the Arizona Game & Fish Department, Research Division, for the Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Arizona Game & Fish Department, Phoenix.
- Runge, M.C., Bean, Ellen, Smith, D.R., and Kokos, Sonja, 2011, Non-native fish control below Glen Canyon Dam—Report from a structured decision-making project: U.S. Geological Survey Open-File Report 2011–1012, 74 p.
- Tyus, H. M., and J. F. Saunders, III. 2000. Nonnative fish control and endangered fish recovery: lessons from the Colorado River. Fisheries 25(9):17–24.
- USGS and BOR. 2014. Glen Canyon Dam Adaptive Management Program Triennial Budget and Work Plan- Fiscal Years 2015–2017, pp. 537.
- USBR. 2012. Environmental Assessment for Development and Implementation of a Protocol for High-Flow Experimental Releases from Glen Canyon Dam, Arizona through 2020, USBR Salt Lake City, UT.
- Walters, C.J., and C.S. Holling. 1990. Large-scale management experiments and learning by doing. Ecology 71:2060–2068.

APPENDIX A - Goals and Desired Conditions for the Lees Ferry Trout Fishery.

NPS Desired Conditions for the Lees Ferry Trout Fishery

- Opportunities for anglers to have a memorable experience.
- Habitat that supports a rainbow trout population with a size structure indicative of a stable population.

NPS Goals for the Colorado River below Glen Canyon Dam

- Maintain a highly valued recreational rainbow trout fishery with minimal emigration of rainbow trout downstream to Grand Canyon National Park,
- Restore and maintain healthy, self-sustaining native fish communities, native fish habitat, and the important ecological role of native fish to the extent possible,
- Foster meaningful tribal relations and integrate tribal knowledge and perspectives into park management decisions and practices, and
- Prevent further introductions of non-native (exotic) aquatic species.

GCD Adaptive Management Program Desired Future Conditions for the Lees Ferry Trout Fishery

- Establish a high-quality sustainable recreational trout fishery in the river corridor in GCNRA, while minimizing emigration of non-native fishes.
- Operate Glen Canyon Dam (GCD) to achieve the greatest benefit to the trout fishery in GCNRA without causing excessive detriment to other resources.

Our Supporters

The following organizations, businesses, and Lees Ferry fishing guides support these Recommendations and encourage their full implementation.

Angler Organizations

- Anglers United
- Arizona Bass Nation
- Arizona Fly Casters
- Arizona Outdoor Sports
- Arizona Sportsmen for Wildlife Conservation
- Arizona Wildlife Federation
- Coconino Sportsmen
- Desert Fly Casters
- International Federation of Fly Fishers
- Northern Arizona Fly Casters
- Payson Fly Casters Club
- San Pedro Fly Casters
- Sun City Grand Hooked on Fly Fishing Club
- The Bass Federation
- Theodore Roosevelt Conservation Partnership
- Trout Unlimited
 - o Arizona State Council
 - o Gila Trout Chapter
 - o Grand Canyon Chapter
 - o Old Pueblo Trout Unlimited Chapter
 - o Zane Grey Trout Unlimited Chapter
- White Mountain Fly Fishing Club
- White Mountain Lakes Foundation

Lees Ferry Fishing Guides

Terry Gunn
Jeff English
Skip Dixon
Natalie Jensen

Tyson Warren
Kevin Campbell
TJ Carrington
Jimmy Daniels

Mick Lovette
Dale Gauthier

Businesses

- Orvis Company
- Lees Ferry Anglers
- Cliff Dwellers Lodge
- Lees Ferry Lodge at Vermillion Cliffs
- Marble Canyon Outfitters

Other Organizations

- Arizona Antelope Foundation
- Arizona Big Game Super Raffle
- Arizona Big Horn Sheep Society
- Arizona Houndsmen
- Arizona Mountain Outfitters
- Audubon Western Rivers Action Network
- Extreme Predator Callers
- Mohave Sportsmen's Club
- Outdoor Experiences for All
- Safari Club International Arizona Chapter
- SRT Outdoors
- South Eastern Arizona Sportsmen's Club
- 123 Go Water Safety

Get involved today!

This is an important time for the Lees Ferry trout fishery. Currently, the Bureau of Reclamation, which manages Glen Canyon Dam, and the National Park Service, which manages the lands in the Colorado River corridor, are preparing a Long Term Experimental and Management Plan EIS that will determine Glen Canyon Dam operations and river restoration actions for next 15-20 years. Over the next year, the coalition of Lees Ferry anglers, sportsmen/conservation organizations, and businesses will be working to incorporate the *Recommendations* into the EIS.

YOUR support is needed. Sign up to receive EIS updates at <http://ltempis.arl.gov/>. Let your elected official know that the Lees Ferry trout fishery is important to you and encourage their support for these Recommendations.

For more information contact:

John Hamill, Arizona Field Representative
Theodore Roosevelt Conservation Partnership
jhamill@trcp.org

John Jordan, Recreational Fishing Representative, Glen Canyon Dam Adaptive Management Program
Trout Unlimited/International Federation of Fly Fishers
jjordan1@cox.net

For the latest news on Lees Ferry and the LTEMP EIS go to: www.az-tu.org

