Lees Ferry Recreational Trout Fishery Management Recommendations: The Voice of Lees Ferry Anglers, Guides, and Businesses

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These recommendations were developed collaboratively among recreational anglers, including: the International Federation of Fly Fishers; Trout Unlimited; Arizona Sportsmen for Wildlife Conservation; Anglers United, Arizona Flycasters Club; Northern Arizona Flycasters; and the Theodore Roosevelt Conservation Partnership. The recommendations were prepared 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.

Executive Summary

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 (NPS) 2014 Comprehensive Fisheries Management Plan (CFMP) for the Colorado River below Glen Canyon Dam. Additionally, the recommendations are provided for the consideration of the AZGFD, Bureau of Reclamation (USBR), Glen Canyon Dam Adaptive Management Work Group (AMWG), and Department of Interior (USDOI) to inform decisions about future management of the blue ribbon rainbow trout fishery in Glen Canyon National Recreation Area and management of Glen Canyon Dam. Another key purpose is to inform future AMWG and Lees Ferry planning processes and help shape alternatives in the Long Term Experimental and Management Plan (LTEMP) Environmental Impact Statement for the future operation of Glen Canyon Dam.

These recommendations are intended to:
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.

This document provides recommendations for management and research actions to achieve these goals and enable resource managers to achieve the conditions defined in the CFMP. Specific management recommendations are provided for:

- Aquatic food base enhancement
- Continue the current modified low-fluctuating flow regime with adjustments to enhance the aquatic food base
- Minimum flows from Glen Canyon Dam
- Spring and fall high flow experiments
- Trout management flows that achieve desired trout recruitment and abundance targets
- Response and mitigation of low dissolved oxygen
- Lake Powell-Lake Mead equalization flows
- Mechanical removal of young trout in Lees Ferry
- Changes in fishing regulations
- Riparian vegetation restoration
- Emergency (contingency) restocking of rainbow trout
- Water temperature control at Glen Canyon Dam
- Introduced turbidity at the confluence of the Paria and Colorado rivers
- Bypass tube electrical generation

Adaptive management through research and corresponding monitoring efforts should be utilized to achieve the desired conditions for the Lees Ferry blue ribbon fishery. Relative recruitment, relative abundance, condition and angler catch rates of trout at Lees Ferry should be carefully monitored and managed. In addition, water quality (e.g., temperature, oxygen and turbidity) should be closely monitored and maintained to avoid catastrophic effects to the tailwater sport fishery.
Background

Anglers from around the world travel to Lees Ferry to fish for high quality rainbow trout in this large, clear, swift-flowing river as it winds its way through the lower, scenic segment of Glen Canyon. This blue ribbon 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 the desert. The fishery itself has changed 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 that is targeted by anglers at Lees Ferry. By agreement with the land and water managers, the 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 reproduction and recruitment of the trout population was

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 Authority, 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.
Glen Canyon Dam was constructed pursuant to the Colorado River Storage Protection 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 Glen Canyon Dam Adaptive Management Program (GCDAMP) was officially established in 1997, under the direction of the Secretary of the Interior, in compliance with the GCPA and the 1996 Record of Decision, which initiated the process "whereby the effects of dam operations on downstream resources would be monitored and assessed."

The implementation of the GCDAMP provided for flexibility in adapting the dam's operations in order to facilitate management actions, scientific research, and monitoring within the parameters of the project purposes for which the dam was constructed.

The recommendations were for which the dam poses for which the dam meets 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 far short of its potential to generate angling recreation and economic wellbeing in northern Arizona.

Our desire is to maintain and enhance the sport fishery as a blue ribbon fishing experience. Based upon those values and desires, we offer objectives, strategies and recommendations that we believe are consistent with the recently completed National Park Service’s CFMP and the AMWG’s Desired Future Conditions (Appendix A) in order to manage the Lees Ferry recreational fishery.

**Purpose and Need**

The Lees Ferry Recreational Fishery Management Recommendations were developed collaboratively by anglers, with valuable input from AZGFD and USGS Grand Canyon Monitoring and Research Center (GCMRC). The recommendations are intended to provide general guidance regarding the objectives for the management of rainbow trout in the Glen Canyon National Recreation Area and are designed to be used by decision-makers including the AZGFD, NPS, USBR, and AMWG to inform management actions and recommendations to the Secretary of the Interior related to dam operations and management of the Lees Ferry trout fishery.

These recommendations include tools and strategies we believe will help ensure the successful achievement of the CFMP Desired Conditions, and help shape alternatives in the Long Term Experimental and Management Plan (LTEMP) Environmental Impact Statement. Our expectation is that these recommendations become a living document that is 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 ribbon 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 (e.g., on an annual basis 20-50 percent of the population will be less than 6 inches in length)
- Healthy abundance of all size classes of rainbow trout (e.g., >1 trout caught/minute during fall electrofishing sampling)
- An angler catch rate of > 1 trout/hour of any size
- An angler catch rate of at least 10 trout/day ≥ 14 inches in length
- An angler catch rate of at least 1 trout/day ≥ 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 economic support for local businesses and Coconino County

- Regain angler use levels ≥ 20,000 angler days per year
- Evaluate the feasibility of establishing a walk-in accessible fishery between the Paria River and Badger Rapid.
- Engage the National Park Service to explore ways to use recreational anglers and local guides to reduce emigration of rainbow trout into Marble Canyon, using approaches that are culturally acceptable to Native Americans.

Recommended Actions to Meet Trout Management Goals and Objectives

Aquatic Food Base Enhancement through Translocations and “Bug Flows”

The current aquatic food base in the tailwater 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). The Lees Ferry aquatic food base is relatively immobile and subject to effects of dewatering due to flow changes, and scouring due to velocity changes.
Changes in the wetted perimeter of the river channel due to daily, monthly or seasonal changes in water delivery may influence the availability and abundance of mayflies, stone flies and caddis flies (also known as Ephemeroptera, Plecoptera, Tricoptera or EPT). The EPT Index is a simple measure of stream quality based upon the abundance of three orders of benthic aquatic insects, premised on the understanding that the highest quality streams have the highest diversity of species in these three orders (Lenat and Penrose, 1996). This relationship holds particularly well when evaluating the aquatic food base for primarily insectivorous fishes like trout and humpback chub. High abundance and diversity of these aquatic insects are reflective of a productive and resilient aquatic ecosystem. The EPT for the Lee Ferry reach is zero, which we believe limits growth and survival of trout to quality sizes. The absence of quality food items impacts the growth and survival of other fishes, such as humpback chub, that are largely dependent upon aquatic insects as forage.

Recommended “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.

Patterns of release from Glen Canyon Dam may have detrimental consequences on trout growth and the abundance of quality trout in the population (USGS and BOR 2014). The processes that affect trout are complex and range from: the influence of water temperature and quality on the physiological capacity of trout to grow; the abundance and diversity of food items needed to provide the sustenance necessary for their growth; the numbers of trout present in the tailwater potentially leading to increased levels of competition for a limited food supply. We support experimental “Bug Flows” to enhance recruitment and survival of a healthy and robust EPT population.

A rich assemblage of EPT and other aquatic food base species are present in the waters above the dam and river tributaries below the dam and were present before the dam was constructed (USGS and BOR 2014). 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 coincidentally with these food base enhancement flows. A series of experimental translocations of these 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 Flow 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**

Minimum flows below 8,000 cfs should be avoided especially when water temperatures are high,
food production is low and/or trout condition is poor. In November 2014, we believe that a combination of low minimum flows of 6,500 cfs in combination with higher water temperatures and low food production contributed to a significant reduction of adult fish in Lees Ferry.

**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, supply camping beaches for river runners, and provide a source of fine sediments that protect archaeological sites from weathering and erosion. The 2008 spring high flows has been hypothesized to have triggered prolific spawning from the wild population of rainbow trout, enhanced recruitment and survival, and enhancing the food base (Korman et al. 2011; Kennedy and Ralston 2011). As a result, 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. In low water release years fall HFE’s can help mitigate the impacts of low minimum flows and high water temperatures that negatively affect the trout at Lees Ferry.

However, we recommend that more emphasis should be placed on conducting HFE’s in the spring as management option for use when the fishery or the aquatic food base has experienced a significant decline (i.e., a significant decline in the trout population and or drop in food production). In addition, 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 a 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. We also believe that additional spring HFE’s are needed to assess the food base and trout response that was observed in 2008.

Triggers for spring high flows should be identified based on trout recruitment, and adult trout population and aquatic food production, in addition to sediment needs. A spring HFE could be used in lieu of or in conjunction with trout stocking, as needed.

**Trout Management Flows (TMFs)**

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. 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). These flows could be used to control the density of rainbow trout at Lees Ferry if composition of the population exceeds 50 percent young-of-year for three consecutive years and electrofishing catch rates exceed one trout/minute. This strategy could be a useful tool to improve the growth and condition of trout at Lees Ferry, or manage the density of trout to control the incidence of whirling disease in the population.

TMFs should have stringent protective sideboards and only be used with the concurrence of
AZGFD. The conditions and parameters under which TMFs will be supported include:

- Experimental evaluation of TMFs should only occur when: 1) the rainbow trout population is stable (i.e., on an annual basis 20-50 percent of the population is less than 6 inches in length), and 2) there is a healthy abundance of all size classes of rainbow trout (>1 trout/minute during fall electrofishing sampling), or 3) established triggers for trout density are exceeded and the humpback chub triggers in the Non Native Fish Control EA are not being met. Experimental TMFs that are implemented that disregard the status of the trout and the humpback chub fisheries are unsupportable and unnecessarily jeopardize the trout fishery. The experimental evaluation of TMFs needs to recognize the trout fishery as a highly valued asset and used only when established triggers are met and measurable criteria for success have been identified.

- 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. The CFMP authorized stocking of triploid (sterile) trout from commercial or governmental sources. The process of stocking should also consider relocating rainbow trout from downstream locations to achieve the CFMP objective of returning rainbow trout of “…multiple age classes” to the fishery. This could reinvigorate the concept of live removal of trout from areas of concern near the mouth of the Little Colorado River using culturally acceptable practices.

**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 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. An action plan should be developed by the Bureau of Reclamation 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 data at the Lees Ferry gage.

**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. 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.

**Mechanical Removal of Young Trout**

As an alternative to TMFs, mechanical removal of young rainbow trout should be considered. Changes in fishing regulations are not effective for removing small trout because small trout are not readily caught, not desired for keeping, and too numerous to make an impact. In an effort to compensate for high levels of reproduction (composition of population exceeds 50 percent young-of-year and electrofishing CPUE is greater than 1 fish/minute) and at the discretion of fisheries
managers, mechanical removal efforts (e.g., electrofishing) should be tested as a tool for reducing the overabundance of small trout from the Lees Ferry reach.

**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 to respond to abundance or quality parameters of the population of trout at Lees Ferry. Public education and outreach campaigns will be necessary to encourage anglers to embrace new harvest regulations and trout population management goals.

**Riparian Vegetation Restoration**

Restoration of riparian vegetation in the Lees Ferry reach should be high priority of the National Park Service. 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**

Successful rainbow trout recruitment depends on a number of factors, some of which are related to changes in, or the effects of, flow. Experiences under the pre-1989 operating criteria have shown that flow conditions during critical juvenile life stages for rainbow trout at Lees Ferry can result in loss of a year’s natural recruitment (McKinney and Persons 1998). Current operating criteria can affect recruitment as well (Korman et al. 2011; Kennedy and Ralston 2011). While compensatory survival can moderate the effects, severe loss of recruitment will have ramifications for the abundance of trout available for recreational fishing. 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.

Stocking is used by fish managers across the world to address low recruitment and catch rates. A contingency stocking plan must be developed by AZGFD with appropriate environmental compliance so that an immediate response to triggers can be implemented, in accordance with the stocking guidelines and triggers included in the CFMP. However, immediate emergency stocking should be implemented in response to a catastrophic fisheries failure. This emergency stocking falls outside the guidelines of the CFMP. To assist in ensuring the ability to stock when needed, a stocking tube should be constructed and maintained below Glen Canyon Dam. Historically, a stocking tube was used below Glen Canyon Dam.

We recommend securing rainbow trout with proper fish health certifications from reputable commercial and governmental sources. Additionally we recommend that management agencies consider translocation of wild rainbow trout from downstream of the Paria River when needed to supplement the trout population within the Lees Ferry sport-fishing reach. Translocation could help achieve multiple goals by enhancing Lees Ferry sportfish opportunities and reducing down river migration of trout.

**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 cool and warm water fishes and other invasive species (e.g., crayfish) 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). In addition, an assessment should be completed of the feasibility of managing Lake Powell and other reservoirs in the Upper Colorado River Basin in a manner that would avoid warm water releases.

**Introduce Turbidity**

It is well established that rainbow trout significantly reduce feeding activity when water clarity is low. Introducing turbidity into the Colorado River below the Paria River may serve to control the abundance of trout and 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. We propose that this activity could serve to mitigate the impact of rainbow trout on downstream resources.

**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 high flow events or to address water quality (dissolved oxygen and temperature) emergencies in the Lees Ferry reach. This could mitigate for loss in power revenue during times of emergency response or during their utilization for high flow events.

**Monitoring and Measurement of Trigger Parameters**

Long-term resource monitoring is the key to effective adaptive management (Walters and Holling 1990). AZGFD has been conducting long term monitoring of the Lees Ferry fishery using creel (angler) surveys since 1964, and standardized electrofishing surveys since 1991. Creel surveys monitor angler use, angler catch and harvest, and satisfaction and are one of the best tools managers have to evaluate a recreational fishery.

Electrofishing surveys 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.

These long-term, ongoing surveys (creel and electrofishing) provide valuable information as it pertains to many of the objectives listed above and are robust enough to detect the changes in the fishery (Bradford et al. 2009). Information gained during these surveys can be applied to address many of the concerns of the angling community, particularly as it relates to angler catch...
and harvest rates, angler use and economic impacts of the fishery. It can also be used to gauge angler satisfaction.

These surveys are an important management tool for the fishery. For example, surveys were used to support the decision to no longer stock trout in Lees Ferry when they indicated the majority of trout by the 1990s were naturally produced, self-sustaining, and not from hatchery releases.

A healthy trout population requires good habitat, a robust food base, and water quality that is conducive to supporting the desired biota. GCMRC has an established water quality monitoring and food base monitoring program that is pertinent to assessing the limitations that exist for achieving the described goals and objectives (Carlisle et al 2012). It is important for those programs to continue to conduct field studies and report conditions as they pertain to the Lee’s Ferry fishery.

Additionally a surveillance plan for other aquatic invasive species (e.g., quagga muscles, 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 report findings rapidly and consistently.

The following are recommended monitoring and measurement goals related to the objectives listed above:

- The objectives of size structure, healthy abundance of all size classes of rainbow trout, and robust body condition should continue to be measured through AZGFD standardized electrofishing.

- The objectives of angler catch rate > 1 trout/hour, angler catch rates of 10 trout/day ≥ 14 inches, and angler catch rates of 1 trout/day ≥ 20 inches should continue to be measured through AZGFD long term angler creel surveys.

- The objective of a diverse aquatic food base EPT levels should continue to be measured through GCMRC food base monitoring program.

- The objective to restore angler use to pre-1999 levels should continue to be measured through AZGFD long-term creel surveys and Glen Canyon National Recreation Area use counts.

In addition, flows, temperature, dissolved oxygen, and nutrient levels should be monitored below Glen Canyon Dam. Channel geomorphology (mapping) and riparian habitat in the Lees Ferry reach should be monitored on a periodic basis.
Literature Cited


APPENDIX A – NPS Comprehensive Fisheries Management Plan desired conditions and goals for the rainbow trout fishery at Lees Ferry and GCD AMP Desired Future 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.