Grand Canyon

National Park Service
U.S. Department of the Interior

Grand Canyon National Park

Environmental Assessment/Assessment of Effect
August 2006

Bright Angel Creek Trout Reduction Project

Grand Canyon National Park ● Arizona

Environmental Assessment
Assessment of Effect

Bright Angel Creek Trout Reduction Project

Grand Canyon National Park ● Arizona

Summary

This combined Environmental Assessment and Assessment of Effect (EA/AEF) has been prepared in compliance with the National Environmental Policy Act (NEPA), as amended, and the National Historic Preservation Act (NHPA), as amended. The National Park Service (NPS) intends to follow 36 CFR 800.8(c), and use the process and documentation required for the preparation of all NEPA documents to comply with Section 106 of the NHPA in lieu of the procedures set forth in sections 800.3 through 800.6.

This EA/AEF evaluates a No Action Alternative (Alternative A), and an action alternative (Alternative B) that proposes mechanical removal of non-native fish species (primarily trout) from Bright Angel Creek in Grand Canyon National Park. The dual purposes of the project are to benefit endangered humpback chub (*Gila cypha*) and other native fish species in the mainstem Colorado River, and to restore and enhance, to the extent possible, the native fish community that once flourished in Bright Angel Creek. To meet these objectives, the preferred alternative proposes to reduce populations of non-native brown trout and, coincidentally, rainbow trout in Bright Angel Creek by means of a weir (fish trap) installed near the mouth of the creek. Trout would also be removed incidental to fish population surveys using electrofishing. The proposed action would begin as early as November 2006 and continue for five years, with annual monitoring and evaluation of the project.

Note to Reviewers and Respondents

This EA/AEF will be on public review for 30 days. You may review the document online at http://parkplanning.nps.gov/grca. If you wish to comment on the document, you may post comments online at.the same web address, or you may mail comments to the name and address below. Our practice is to make comments, including names, home addresses, home phone numbers, and email addresses of respondents, available for public review. Individual respondents may request that we withhold their names and/or home addresses, etc., but if you wish us to consider withholding this information you must state this prominently at the beginning of your comments. In addition, you must present a rationale for withholding this information. This rationale must demonstrate that disclosure would constitute a clearly unwarranted invasion of privacy. Unsupported assertions will not meet this burden. In the absence of exceptional, documentable circumstances, this information will be released. We will always make submissions from organizations or businesses, and from individuals identifying themselves as representatives of or officials of organizations or businesses, available for public inspection in their entirety.

Comments must be postmarked or posted online no later than October 2, 2006. Please address comments to:

Joseph F. Alston, Superintendent
Grand Canyon National Park
Attention: Office of Planning and Compliance
P.O. Box 129 / 1 Village Loop
Grand Canyon, Arizona 86023

For further information concerning this document, or to obtain a paper or electronic copy of the document, contact Rick Ernenwein, Project Planning Leader, at the above address or call (928) 779-6279.

CHAPTER 1 – PURPOSE AND NEED FOR ACTION

INTRODUCTION

The National Park Service (NPS) proposes to enhance native fish populations and restore natural ecosystem values within Bright Angel Creek by reducing the population of non-native brown (*Salmo trutta*) and, coincidentally, rainbow trout (*Oncorhynchus mykiss*). Bright Angel Creek, a tributary of the Colorado River, is located within Grand Canyon National Park (GRCA), Coconino County, Arizona, as shown in Figure 1. Trout would be removed from the creek during their spawning season (October-January) each year for five years; the effectiveness of the reduction program would be assessed by monitoring population changes in the Bright Angel Creek native fish community.

This combined Environmental Assessment and Assessment of Effect (EA/AEF) has been prepared in compliance with the National Environmental Policy Act (NEPA), as amended, (and NPS policies and guidance related to NEPA), and with the National Historic Preservation Act (NHPA), as amended. The NPS intends to follow 36 CFR 800.8(c), and use the process and documentation required for the preparation of all NEPA documents to comply with Section 106 of the NHPA in lieu of the procedures set forth in sections 800.3 through 800.6. In compliance with NEPA, this EA/AEF provides the decision-making framework that 1) analyzes a reasonable range of alternatives to meet project objectives, 2) evaluates potential issues and impacts to Grand Canyon National Park's resources and values, and 3) identifies mitigation measures to lessen the degree or extent of these impacts. This document is also tiered to the U.S. Department of the Interior's (DOI) EA for the Proposed Experimental Releases from Glen Canyon Dam and Removal of Non-Native Fish (DOI 2002), which addresses reduction of trout in the Colorado River in GRCA.

PURPOSE AND NEED

The dual purposes of the proposed action are to benefit endangered humpback chub (*Gila cypha*) and other native fish species in the mainstem Colorado River, and to restore and enhance, to the extent possible, the native fish community that once flourished in Bright Angel Creek. Bright Angel Creek historically supported large populations of native speckled dace (*Rhinichthys osculus*), as well as native suckers and occasionally chubs (Minckley 1978, Carothers and Minckley 1981). In recent years, the creek's fish community has been dominated by non-native trout (salmonids). Otis (1994) reported finding numerous brown trout but very few speckled dace in seven sampling trips in 1992-1993. This situation parallels a documented and accelerating decline in native fish populations throughout the Colorado River system and in GRCA (Holden and Stalnaker 1975, Valdez and Carothers 1998, Coggins et al. 2002, Van Haverbeke and Coggins 2003). Predation by and competition with the large number of non-native salmonids in the Colorado River and its tributaries are contributing factors to this decline (Valdez and Ryel 1995, Marsh and Douglas 1997, Coggins et al. 2002). However, in recent information provided by the Grand Canyon Monitoring and Research Center (GCMRC 2006), it appears that the humpback chub population in Grand Canyon may be stabilizing. Bright Angel Creek provides important spawning habitat for brown and rainbow trout, which are predators on humpback chub and other native fishes (Minckley 1978, Carothers and Minckley 1981, Otis 1994, Marsh and Douglas 1997, Rowell 2001). Interrupting the annual spawning cycle by removing adult trout as they aggregate in Bright Angel Creek is a feasible and potentially effective method for reducing numbers of trout, particularly brown trout, to benefit humpback chub and other native fishes.

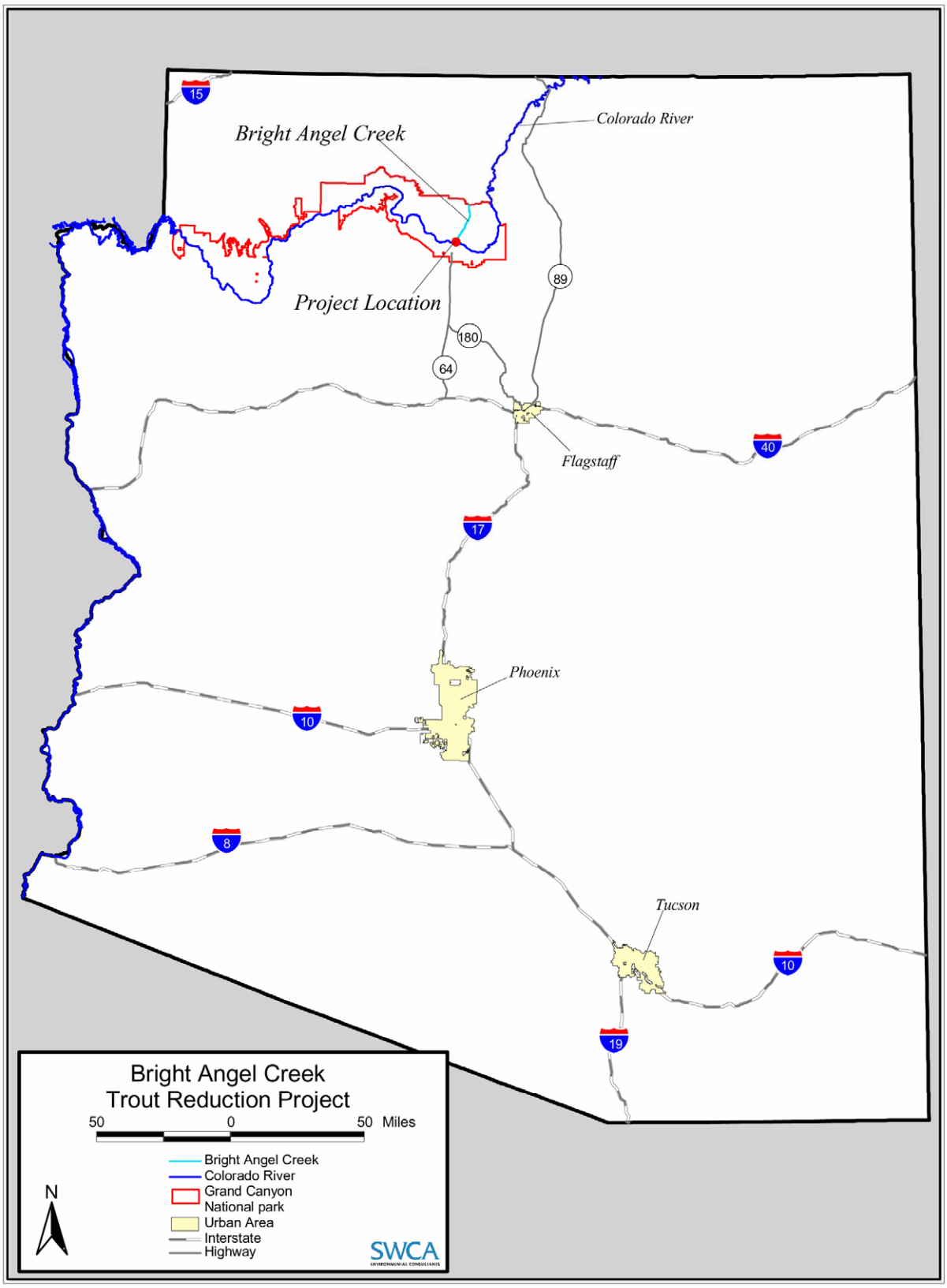

Figure 1. Project location.

Federal Legislative and Policy Mandates

The proposed action is consistent with the NPS Management Policies 2001 that require national parks to maintain native plants and animals as parts of natural ecosystems, and to remove established populations of exotic (i.e., non-native) species. Specifically, NPS Management Policies 2001 call for the eradication of exotic species if their control is prudent and feasible and if those species interfere with the perpetuation of native species. Total eradication of non-native trout from Bright Angel Creek would be difficult to achieve using solely mechanical means; however, populations can be substantially reduced and maintained at low levels, thus decreasing competition and predation pressures on speckled dace and other native fish.

The proposed action also conforms to the NPS Organic Act of 1916, which mandates national parks to conserve the natural resources found therein and to manage those resources to avoid their impairment. Actions designed to protect and restore the native species that comprise the Park's natural aquatic community further the intentions of that Act. Reducing threats to a federally listed species (the endangered humpback chub) by reducing mainstem populations of predacious trout is also consistent with NPS directives to comply with the Endangered Species Act of 1973, as amended, and with the non-native fish control measures in the U.S. Fish and Wildlife Service (USFWS) recovery goals for the humpback chub (USFWS 2002a).

Finally, the proposed action furthers GRCA's management objectives as articulated in the Park's 1995 General Management Plan. Specifically, the project would help the Park meet the following objectives:

- To the maximum extent possible, restore altered ecosystems to their natural conditions. In managing naturalized ecosystems, ensure the preservation of native components through the active management of non-native components and processes.

- Manage ecosystems to preserve critical processes and linkages that ensure the preservation of rare, endemic, and specially protected (threatened/endangered) plant and animal species.

Background

In GRCA, few systematic studies were conducted on fish populations in the Colorado River and its tributaries before Glen Canyon Dam was completed in 1963, and none were conducted before warm-water, non-native fish began to invade the mainstem at the end of the nineteenth century and before trout were introduced in the 1920s. Eight native species were indigenous to the system: humpback chub, roundtail chub (*Gila robusta*), bonytail (*G. elegans*), speckled dace, flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus)*, razorback sucker (*Xyrauchen texanus*), and Colorado pikeminnow (*Ptychocheilus lucius*). Of these eight, speckled dace, flannelmouth sucker, bluehead sucker, razorback sucker, and one or more species of chub have been documented from Bright Angel Creek (Minckley et al. 1991, Otis 1994, Valdez and Carothers 1998). The endangered humpback chub was initially described as a species from a specimen taken near the mouth of Bright Angel Creek (Miller 1946).

Surveys conducted in Grand Canyon in the last 40 years have confirmed that three native species—roundtail chub, bonytail, and Colorado pikeminnow—have been extirpated from the Park, and a fourth, razorback sucker, may be gone as well (Valdez and Carothers 1998). Until recently, the population of endangered humpback chub appeared to be in decline (Humpback Chub Ad Hoc Committee 2003, Coggins et al. 2003), and biologists were concerned about the remaining three native species. However,

in recent information provided by the Grand Canyon Monitoring and Research Center (GCMRC 2006), it appears that the humpback chub population in Grand Canyon may be stabilizing. The decline of the native fish assemblage in Grand Canyon has been attributed to the radical alteration of the aquatic environment by Glen Canyon Dam, and to competition and predation by over 20 species of non-native fish, including trout, that have invaded or been introduced into the system (Valdez and Carothers 1998). Predation and competition by non-native fish have been implicated in the decline of native fish species throughout the Colorado River system, not solely within GRCA (Hawkins and Nesler 1991, Blinn et al. 1993, Upper Colorado River Endangered Fish Recovery Program 2002). Efforts to reduce and control non-native species are continuing in several localities throughout the Colorado River Basin, including the mainstem Colorado River in Grand Canyon (U.S. Department of the Interior 2002, Yard and Coggins 2003). The proposed action would contribute to this multifaceted, system-wide attempt to salvage and restore native fish species.

MANAGEMENT AND PLANNING HISTORY

The U.S. Forest Service conducted the first known introductions of non-native fish in accessible tributaries of the Grand Canyon for a number of years prior to the creation of the national park in 1919 (Williamson and Tyler 1932 cited in Carothers and Minckley 1981). After the Park was established, the NPS introduced various trout species (brook trout [*Salvelinus fontinalis*], rainbow trout, brown trout) into Bright Angel Creek in numerous episodes between 1920 and 1964 (Haden 1992). All stocking of non-native fish ceased in the Park after 1972, but the Arizona Game and Fish Department (AGFD) continued to stock rainbow trout in the Colorado River just upstream of the park boundary into the 1990s.

According to Sellars (1997), during the years that non-native species were stocked in GRCA waters, federal agencies like the NPS were responding to prevailing social values and public demand by giving sport fishing a higher priority than preservation of native aquatic communities. This management practice was acknowledged during the 1930s to be an "important exception to general [NPS] policy," but it was believed that recreational benefits overruled the biological "disadvantages which are incidentally incurred" (Wright et al. 1933 cited in Sellars 1997). Social values began to shift in the mid-twentieth century as the scientific community, the public, and government agencies increasingly understood that introduced species could disrupt entire ecosystems and lead to the decline and extinction of native species. Reflecting the growing public understanding and appreciation of ecological values, the NPS became increasingly reluctant to make an "exception to general policy" when it came to sport fishing in national parks. That "general policy" was and is rooted in the NPS Organic Act of 1916, the founding legislation of the National Park Service.

NPS management objectives and practices now favor preserving native fish communities over non-native sport fisheries where exotic species are not maintained to meet an identified park purpose. The Fish Management Plan for GRCA of 1981, referencing the National Park Service Management Policies Handbook (1978), stated that management of fish resources shall be "Specifically aimed toward preservation or restoration of the full spectrum of native species, including fish" and "no artificial stocking of exotic fish species will occur; artificial stocking of fish may be employed only to re-establish native species." Currently, the GRCA Resource Management Plan (1997) identifies the threat posed by non-native species to park wildlife resources as a major issue, and states that "In cases where funding and personnel levels allow and where success is likely, control measures will reduce alien species populations."

In 2002-2003, GRCA coordinated with the Grand Canyon Monitoring and Research Center (GCMRC) to conduct a feasibility study to determine the efficacy of using a weir in Bright Angel Creek to capture and remove brown trout. The study was performed by biologists from SWCA Environmental Consultants

(SWCA), under contract to GRCA, with funding from the NPS and the U.S. Bureau of Reclamation (USBR). Biologists captured 423 brown trout and 188 rainbow trout during the 64 days of weir operation (November 18, 2002-January 21, 2003) (SWCA 2003). Included in the catch was one bluehead sucker. After the pertinent data were collected, the rainbow trout and bluehead sucker were released above the weir; the brown trout were sacrificed and packed out of Grand Canyon. The study confirmed the effectiveness of removing spawning trout from Bright Angel Creek. In a related project, biologists under contract to the NPS conducted population surveys in additional Colorado River tributaries (Shinumo, Tapeats, Kanab and Havasu Creeks) in 2004 and 2005 to determine baseline fish populations. The ultimate purpose of the effort is to restore and conserve the native fish assemblages in those tributaries. In 2006, a predator load survey was conducted in Bright Angel Creek that determined the effectiveness of using backpack electrofishing as a management tool for population sampling and non-native fish removal. (SWCA et al 2006).

Internal Scoping
This project was initially discussed among the various groups associated with the Glen Canyon Dam Adaptive Management Program (GCDAMP). A feasibility study was conducted as described above, and the results further discussed among the GCDAMP groups. A project proposal and environmental screening form was reviewed by the park's Project Review Board and Parkwide Interdisciplinary Team in 2003. An internal NPS review of the draft EA/AEF was conducted in September 2005.

Public Scoping
The details of public scoping are presented in Chapter 4 (Consultation and Coordination). In summary, public scoping occurred from December 2003 – January 2004. In addition, this project (along with the trout removal project in the mainstem Colorado River) has been a frequent topic of discussion at meetings associated with the Glen Canyon Dam Adaptive Management Program, which includes tribes, other agencies, and stakeholders interested in the river corridor in the park.

EA/AEF Distribution
A letter announcing the availability of the EA/AEF is being distributed to those who responded to the public scoping efforts and to the park's mailing list of agencies, tribes and stakeholders who have expressed interest in such projects. Availability of the EA/AEF for public review is also being advertised through the NPS Planning, Environment and Public Comment (PEPC) website (http://parkplanning.nps.gov/grca), and through a press release. The EA/AEF is available electronically at the PEPC website, and can also be obtained in paper or electronic form by contacting the park.

Agencies and Tribes
In addition to the agencies and tribes associated with the Glen Canyon Dam Adaptive Management Program who continue to be contacted about this project through that program, all applicable agencies, tribes and government representatives are being sent letters concerning the availability of this EA/AEF.

ISSUES AND IMPACT TOPICS

Issues and impact topics related to this proposal were identified as a result of internal and public scoping (see Chapter 4, Consultation and Coordination for more information). During the 30-day public scoping period for this project (December 2003 – January 2004), 50 individuals, organizations, and agencies provided input. While all comments were carefully considered, some were found to be outside the scope of this project (e.g., additional actions to restore Bright Angel Creek not directly related to fish). A number of commenters believed that the proposed action had been implemented before the public scoping period, some responding to an incorrect date in the scoping letter indicating that the weir would first be installed in 2003 when it should have said 2005 (and now it is proposed to be installed in 2006 or 2007).

Some commenters also incorrectly appeared to believe that the 2002 feasibility study was the part of the proposed action; it was not. Many respondents were interested in trout fishing and did not support removing trout from the creek. Others were generally supportive of efforts to enhance and restore the creek's environment.

.

Comments that directly affected the alternatives or analysis included:

- Reducing trout in Bright Angel Creek would result in the loss of a valuable sport fishery.
- What are the potential impacts to native fish populations?
- The NPS should consider the economic repercussions.
- The proposed action, when coupled with trout reduction activities in the Colorado River, may result in the eradication of trout in Grand Canyon and the loss of the Lees Ferry sport fishery.
- Trout will continue to invade Bright Angel Creek from the Colorado River.
- NPS should consider other trout removal efforts, such as harvest by anglers, alternative barrier structures, and piscicides (toxicants).

Impact Topics Analyzed in This Document

Aquatic Resources – NEPA calls for an examination of the impacts on the components of affected ecosystems, which for this proposed action includes aquatic resources. Impacts to aquatic resources are anticipated because it is the intent of the proposal to alter the fish species composition of Bright Angel Creek, substantially reducing the abundance of non-native trout to allow for the increase of native fish species. The action would have a direct effect on individual non-native fish in the creek's ecosystem and is anticipated to have an indirect effect on native fish species and other aquatic ecosystem components. Aquatic resources will be addressed in Chapter 3 of this document.

Special Status Species – The 1973 Endangered Species Act, as amended (ESA) requires an examination of impacts to all federally listed threatened or endangered species for any major action authorized, funded, or carried out by a federal agency. In addition, NPS policy requires examination of the impacts to state-listed and federal candidate species. Six special status species either are known to occur or may occur in the project area and have the potential to be affected by the proposed action. Of these, two species are both federally listed by the USFWS and considered Wildlife of Special Concern in Arizona (WSCA) by the AGFD. They are **humpback chub** (*Gila cypha*) and **razorback sucker** (*Xyrauchen texanus*). One species, **bald eagle** (*Haliaeetus leucocephalus*), is just federally listed, and another two, **northern leopard frog** (*Rana pipiens*) and **osprey** (*Pandion haliaetus*), are state listed. The sixth special status species that may be affected, **flannelmouth sucker** (*Catostomus latipinnis*), is not listed but is considered a Species of Concern by the USFWS. All six species will be addressed in Chapter 3 of this document.

Ethnographic (traditional cultural properties) – Executive Order 13007 requires federal agencies "to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites." There is a potential for the project to affect sacred sites or other traditional cultural properties; therefore, this subject will be further evaluated under Cultural Resources in Chapter 3.

Visitor Experience – The NPS Organic Act of 1916 and the NPS Management Policies 2001 direct national parks to provide for public enjoyment, including recreational opportunities. Reducing trout populations in Bright Angel Creek would affect angling for trout in that stream, one of the recreational

opportunities currently available in GRCA. Visitor experience will be addressed in Chapter 3 of this document.

Impact Topics Dismissed from Further Analysis

The NPS reviewed the topics listed below and determined that the impacts, if any, for these topics will be at a minor level or less in degree so the topics have been dismissed from detailed analysis in this document, for the reasons stated.

Cultural Resources – Consideration of impacts on cultural resources is required by the National Historic Preservation Act of 1966, as amended; Archeological Resources Protection Act of 1979; Native American Graves Protection and Repatriation Act of 1990; NPS Management Policies 2001; and other federal statutes, policies, and guidelines. In addition, NEPA regulations at 40 CFR 1508.27 require that the intensity of potential impacts be evaluated in terms of potential adverse effects on archaeological and other cultural resources, including historic properties listed on or eligible for inclusion in the National Register of Historic Places. The direct effects of the project are confined within Bright Angel Creek and the Colorado River as defined for the area of effect; there are no known historic properties within the creek or river that may be affected by the project, so those cultural resources will not be further evaluated in Chapter 3.

Floodplains – Executive Order 11988 requires federal agencies to examine potential risk and impacts of placing facilities within floodplains. The proposed action would take place within Bright Angel Creek; however, it would not involve any alteration of the stream channel or existing streamflow patterns, and would therefore not affect the Bright Angel Creek floodplain.

Indian Trust Resources – Under DOI Secretarial Order 3175 and DOI Environmental Compliance Memorandum 95-2, agencies of the department are required to consider the effects of their actions on Indian trust assets, which are defined as legal interests in property held in trust by the federal government for the benefit of Indian tribes or individuals. Examples of such assets include lands, mineral rights, hunting and fishing rights, and water rights. There are no Indian trust resources at GRCA. Therefore, the project would have no effects on Indian trust resources, and this subject will not be further analyzed in Chapter 3.

Wetlands – Executive Order 11990 requires federal agencies to avoid impacts on wetlands where possible. In addition, NEPA regulations at 40 CFR 1508.27 require that the intensity of potential impacts be evaluated in terms of potential adverse effects on wetlands. Some wetland areas do occur along Bright Angel Creek; however, no activities associated with the proposed action would encroach upon them or alter their values or functions.

Special Status Species - While some special status species known or likely to occur in Coconino County, Arizona, will be analyzed in this document in Chapter 3, most will not. The majority of federally listed and candidate species and most state-listed species in Coconino County would not be affected by the proposed action. Either they do not occur in or near the project area, or potentially suitable habitat for them is not present within the area potentially affected. (See Table A-1 and Table A-2 in Appendix A for complete lists of federal and state special status species.)

Four federally listed species are known to occur or may occur in Bright Angel Canyon but would not be affected by the proposed action. 1) Endangered Kanab ambersnail (*Oxyloma haydeni kanabensis*) is known from only two localities in Grand Canyon, neither of which is within 25 miles of the project area;

however, potentially suitable habitat is present in springs emanating from limestone and sandstone formations in upper Bright Angel Canyon. No project activity would take place in spring habitats, nor would any resulting changes in the creek's fish assemblage affect Kanab ambersnails if they were present. 2) Threatened Mexican spotted owls (*Strix occidentalis lucida*) nest in the upper reaches of the canyon, but no work would take place within 0.5 mi of a Protected Activity Center (PAC). The level of human activity and sound associated with the proposed action would be too low to disturb nesting owls. 3) Endangered southwestern willow flycatchers (*Empidonax traillii extimus*) may visit riparian habitat along Bright Angel Creek during spring and fall migrations, but that habitat is not suitable for nesting flycatchers. Removing trout from the creek may result in a slight (below detectable levels) increase in flying aquatic insects that could potentially benefit foraging flycatchers. The intensity of that potential indirect, beneficial impact would be negligible at most. 4) California Condor is federally listed as endangered, but is an experimental, nonessential population in Arizona and treated as a threatened species in GRCA. Several condors have become habituated to human presence in the Park and visit Phantom Ranch and the Bright Angel Campground looking for food. They may approach project personnel. If that should happen, the biologists would follow NPS-approved procedures (see the "Mitigation Measures" section of Chapter 2). It is unlikely that the proposed action would affect California condors.

A fifth species, American peregrine falcon (*Falco peregrinus anatum*), was removed from the federal endangered species list in 1999, but the Park will continue to treat it as a listed species through August 2004 (5 years after delisting). Peregrine falcons are also categorized as WSCA. They are known to nest near Bright Angel Canyon and forage throughout the region. No activity associated with the proposed action has the potential to adversely affect this species. Peregrine falcons may benefit indirectly from a potential slight increase in the availability of insects because insectivorous birds, such as swifts and swallows, form an important component of this species' prey base.

Two additional WSCA species are known to or may occur in Bright Angel Canyon but would not be adversely affected by the proposed action. They are western red bat (*Lasiurus blossevillii*) and spotted bat (*Euderma maculatum*). These bats are insectivorous and could benefit if the propped action results in an increase in available insects. As with southwestern willow flycatchers and peregrine falcons, any such benefit would be negligible at best.

Environmental Justice – Executive Order 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects on minority and low-income populations. In the past, some of the fish killed in trout removal efforts in the park have been used by local Indian tribes as fertilizer for gardens or farms; however, this is a potentially beneficial effect, so it is not an environmental justice concern. This topic was dismissed from further analysis because each alternative would affect everyone equally and would not disproportionately impact minority or low-income populations.

Ecologically Critical Areas, Wild and Scenic Rivers, or other unique natural resources – NEPA regulations at 40 CFR 1508.27 require that the intensity of potential impacts be evaluated in terms of potential adverse effects on ecologically critical areas, wild and scenic rivers, or other unique natural resources. No such resources or special designations occur in the proposed project area. The proposed action would not compromise the eligibility of Bright Angel Creek for future designation as a Wild and Scenic River, nor would it compromise the future designation of any portion of GRCA as wilderness under the Wilderness Act of 1964. The proposed action would take place within the cross-canyon corridor, which was excluded from the Park's Final Wilderness Recommendation (1993) as either proposed or potential wilderness.

Prime and Unique Farmland –NEPA regulations at 40 CFR 1508.27 require that the intensity of potential impacts be evaluated in terms of potential adverse effects on prime and unique farmlands. Prime farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables and nuts. No such farmlands occur in the project vicinity or would be affected by the project.

Possible conflicts between the proposal and land use plans, policies, or controls for the area concerned - NEPA regulations at 40 CFR 1502.16 require that potential land use conflicts be addressed if they occur. The proposed project area is entirely within the boundaries and jurisdiction of GRCA, which is managed according to the Park's General Management Plan of 1995. The proposed action is fully consistent with the management objectives set forth in that plan.

Urban Quality and Design of the Built Environment – NEPA regulations at 40 CFR 1502.16 require that urban quality and design of the built environment be considered if they are potentially affected. No urban areas occur in the vicinity of the proposed action, and the built environment in the Phantom Ranch area would not be affected by a temporary weir structure in Bright Angel Creek.

Energy Requirements and Conservation Potential – NEPA regulations at 40 CFR 1502.16 require that energy requirements or conservation potential be considered if they are potentially affected. Implementation of the proposed action would not affect any energy resources within the park.

Public Safety – NEPA regulations at 40 CFR 1508.27 require that the intensity of potential impacts be evaluated in terms of potential adverse effects on public health and safety. The proposed action involves electrofishing, which does have a slight potential to harm crew and park visitors. However, with the appropriate application of the mitigation measures listed in Chapter 2 for the use of electrofishing equipment, no impacts to public safety are expected.

Geologic Resources – No ground-disturbing activities would take place as part of the proposed action. Project personnel, when entering and exiting the creek, would use unvegetated, stony banks whenever possible to minimize streambank erosion. With this mitigation measure in place, the proposed action is expected to have a negligible impact on soils or other geologic resources.

Water Resources – The Clean Water Act of 1972 requires consideration of impacts on jurisdictional waters of the United States and the potential for polluting surface waters. The proposed action would not divert or deplete streamflow or modify stream channel morphology. A U.S. Army Corps of Engineers 404 permit would, therefore, not be necessary. The proposed action does not involve the use of any contaminants in or around Bright Angel Creek. Biologists wading in the water during weir operations and electrofishing may stir up bottom sediments, temporarily and locally increasing turbidity at a negligible level. The streambed of Bright Angel Creek, however, is largely armored with gravel, cobbles, and boulders, with little fine-grained sediment that can be easily suspended. Even short-term effects to water quality would be negligible.

Air Quality – As a federally mandated Class I area under the Clean Air Act, GRCA receives stringent protection against increases in air pollution and further degradation of air quality-related values. Section 118 of the Act requires all federal facilities to comply with existing federal, state, and local air pollution control laws and regulations. Impacts to park air quality or regional air quality are not expected from the proposed action because no equipment used would generate emissions and no activities would result in airborne dust. The scope of this project does not require consultation with the State of Arizona regarding air quality.

Soundscapes – The NPS has a mandate (NPS Management Policies 2001) to protect, maintain, or restore a park's natural soundscape in a condition unimpaired by inappropriate or excessive noise sources. Operation of the weir would generate no noise, and the backpack electrofisher used for the population survey in Bright Angel Creek would be powered by noiseless batteries. As a result, there would be no effect from the proposed action on the Park's soundscape.

Terrestrial Biological Resources –NPS Management Policies 2001, the 1995 General Management Plan, and other NPS and park policies provide for the protection of the Park's naturally occurring biotic communities. Activities associated with the proposed action would not contribute detectably to current levels of streamside use by visitors. Travel between upstream or downstream portions of Bright Angel Creek would be via the established trail adjacent to the stream. Biologists entering and leaving Bright Angel Creek as part of electrofishing operations would choose routes that avoid streamside vegetation to minimize trampling. Any incidental impact to riparian vegetation would therefore be negligible. The level of noise and human activity associated with the proposed action would be low and no terrestrial wildlife habitats would be altered; therefore, it is unlikely that terrestrial wildlife would be disturbed at more than a negligible level as a result of the project.

Invasive Exotic Species – Executive Order 13112 on Invasive Species directs federal agencies to use relevant programs and authorities to prevent the introduction of invasive species; to provide for their control; and to minimize the economic, ecological, and human health impacts that invasive species cause. In keeping with this directive, all equipment (including personal gear like waders) associated with the proposed action would be cleaned prior to use to ensure that no invasive species are introduced into the project area. Project personnel would be instructed to look for non-native New Zealand mudsnails (*Potamopyrgus antipodarum*) in particular and to ensure that none are brought into the area or transported from one location to another. With this mitigation measure in place, the proposed action is not expected to aid in the spread of invasive exotic species.

Socioeconomic Resources –The primary economic beneficiary of sport fishing at Bright Angel Creek is Xanterra Parks and Resorts, the concessioner that manages the lodge at Phantom Ranch and provides transportation by mule in and out of the Canyon. Xanterra expects no loss of revenue as a result of the proposed action (Streik 2004). Phantom Ranch operates at full or near-full occupancy year-round, with demand for its limited accommodations exceeding supply. While some people do visit the Bright Angel Creek area principally or solely to fish, and would not book mule rides or over-night accommodations if sport fishing were to diminish, they constitute a very small minority of Xanterra's clientele park-wide. Diminishment of the Bright Angel Creek sport fishery would also have a negligible effect on the sale of fishing licenses and trout stamps in the state. In-state anglers likely fish at other locations and would continue to purchase licenses. Out-of-state visitors who buy licenses for use only at Bright Angel Creek account for an insignificant proportion of total licenses sold in Arizona each year. Xanterra stopped selling fishing licenses at Phantom Ranch several years ago due to the low level of interest. The trout removed from the creek would not be handled in such a way that they could be used for food; in any case, there would normally not be enough collected at any one time to be a commercial food source, and there are policy issues with any consideration of commercial fishing in a park. Since there is less than a minor impact expected for any entity, this topic is dismissed from further analysis.

Park Operations – The NPS would outsource most of the work associated with the proposed project, but some support would be required from park personnel and equipment to transport fish remains out of the project area and to transport large gear in and out of the Canyon. Park rangers would help biologists educate visitors about the purpose of the action and provide routine support and law enforcement. Housing or other accommodations would be necessary in the Phantom Ranch area for the biologist(s)

operating the weir and electrofishing. These services are expected to have minor or negligible effects on park operations, so this topic will not be analyzed further.

Wilderness – Bright Angel Creek is located in the Cross-Canyon Corridor, which is not included in the park's recommended or potential wilderness. Although this is not analyzed throughout this document, there will be minor beneficial impacts to wilderness character from the preferred alternative because it enhances the natural conditions of Bright Angel Creek and the Colorado River. However, helicopter flights may rarely be needed in support of the actions in Bright Angel Creek. A Minimum Requirements Analysis (MRA) will be prepared for any needed helicopter support to mitigate effects to areas adjacent to the Cross-Canyon Corridor that are recommended for wilderness designation. Effects to wilderness are therefore expected to be minor or negligible, so will not be analyzed further.

CHAPTER 2 – ALTERNATIVES

INTRODUCTION

This chapter describes two alternatives. They are Alternative A: No Action and Alternative B: Mechanical Removal (Preferred Alternative). Alternatives considered but eliminated from further study are described as well. The predicted impacts of Alternatives A and B are summarized in Table 1 at the end of this chapter and analyzed in Chapter 3. Finally, Table 2 provides a summary of the alternatives and how well each alternative meets project objectives.

DESCRIPTION OF ALTERNATIVES

Alternative A – No Action

Under this alternative no changes would be made to the existing environment. Trout and other non-native fish from the mainstem of the Colorado River and its tributaries would continue to be allowed to spawn in Bright Angel Creek without human interference. This alternative would not address the purpose and need identified in Chapter 1 of this document.

Alternative B – Mechanical Removal (Preferred Alternative)

Alternative B is the NPS preferred alternative and is the proposed undertaking for §106 compliance. All actions described in the preferred alternative are consistent with the approved 1995 general management plan and related park documents. Under Alternative B, trout would be mechanically removed from Bright Angel Creek using 1) a weir to capture them as they move upstream into the creek to spawn (Figure 2), and 2) electrofishing and dip netting to capture additional trout in the stream. The effectiveness of the reduction program would be assessed by monitoring population changes in the Bright Angel Creek fish community. This alternative is based upon a feasibility study conducted November 2002 through January 2003, which determined that using a weir was successful at removing trout from Bright Angel Creek (SWCA 2003), and a non-native fish population survey in March 2006 which determined the effectiveness of using backpack electrofishing as a management tool in Bright Angel Creek (SWCA 2006).

Trout Removal by Weir

A weir is a fence-like barrier erected across a stream (Figure 2). Water flows through the structure, but fish above a certain size are diverted to a trap. Beginning as early as November 2006, the weir would be installed in November of each year and operated for approximately 70 consecutive days throughout the trout spawning season (November-January). At the end of this period, the weir would be removed. The most likely location for the weir would be in the creek downstream of Phantom Ranch near the footbridge by the NPS river ranger station. This unobtrusive site worked well during the feasibility study, but other suitable locations may be selected where stream depths are appropriate. The reduction efforts would continue annually for five years, with annual monitoring and evaluation of the project.

The weir would be operated to capture all large-bodied fish moving upstream. Speckled dace, a small-bodied native fish, would be able to pass through the weir so would not be captured. Fish would be handled and processed according to the procedures developed by the Arizona Game and Fish Department for conducting fisheries research in Grand Canyon (Ward 2002). Only qualified biologists would handle

and tag fish. All captured fish would be identified as to species, counted, measured, inspected for reproductive condition, and scanned for the presence of PIT tags (passive integrated transponders). Untagged native fish would be injected with a PIT tag. All trout would be examined for an adipose fin clip, indicating the presence of a PIT tag. Data would be recorded on standardized data sheets.

Native fish species would be released above the weir, but all trout would be euthanized. All euthanization would be performed in a humane manner consistent with policy and law (e.g., the Animal Welfare Act). Stomachs of a sub-sample of trout would be removed and preserved for later analysis to ascertain food habits. The non-native fish carcasses would be preserved and transported out of the Canyon. The fish remains would be made available for such uses as garden composting, but final disposition of the carcasses would be determined after consultation with Native American tribes.

At least one biologist would be present at all times during weir operations to perform the following tasks: 1) ensure that the weir is operating properly, 2) check and remove fish from the trap as frequently as necessary, 3) clear away accumulated debris, 4) ensure that no other wildlife or non-target fish species are negatively affected by the weir, 5) remove the weir should a flooding event or safety issue occur, and 6) answer any inquiries from park visitors about the purpose and need for the weir. Three biologists would conduct the electrofishing effort (see below). A report assessing the effectiveness of the effort would be prepared each year.

Fish Community Response Monitoring

To determine the effects of trout reduction on the fish community in Bright Angel Creek, population changes in that community would be monitored annually. Two approaches would be used: 1) Population estimates of fish species present in the creek would be determined using electrofishing and the depletion survey method; and 2) a weir would be placed in the creek during the spring to capture and census native flannelmouth and bluehead suckers moving into Bright Angel Creek to spawn.

The population surveys would require multiple, consecutive passes of defined reaches of stream using a backpack electrofisher such as the Smith-Root LR24. The number and locations of the reaches have yet to be determined, but initial efforts would be focused between the mouth of Bright Angle Creek and the confluence with Phantom Creek. These population surveys would include two 5-day episodes of electrofishing in November-January and two 5-day episodes in April-May.

An electrofisher would introduce a mild electrical current into the water, causing fish to swim toward the anode of the shocker where they would be scooped up with dip nets. Captured fish would be held in live-wells (porous tanks) located in the creek outside the depletion reach. Three or four passes would be needed to complete the survey. After each pass, all fish captured in that pass would be counted by species and the data recorded for later statistical analysis. The population estimates derived by this method would be compared over multiple years to obtain information about population changes through time.

Additional data collected during the electrofishing would include the length and condition of each fish captured. All fish except speckled dace would be scanned for the presence of PIT tags, and untagged native fish other than speckled dace would be injected with a new PIT tag. All trout would be examined for an adipose fin clip. Native fish would be returned to the creek; all trout and other non-native fish would be euthanized. Stomachs of a sub-sample of trout would be removed and preserved for later analysis. The carcasses would be disposed of as previously described.

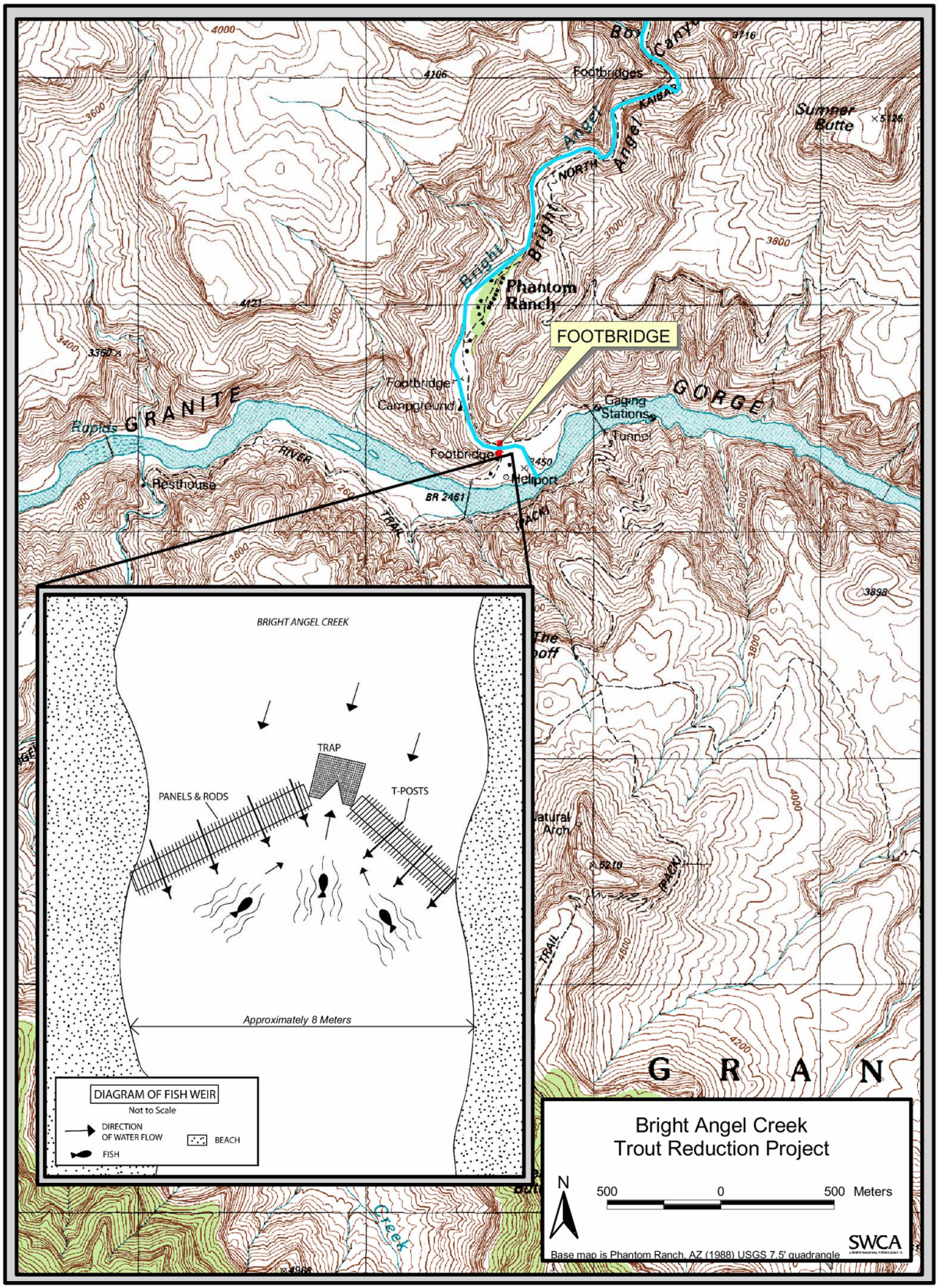

Figure 2. Diagram and probable location of fish weir.

To monitor spawning flannelmouth and bluehead suckers moving into Bright Angel Creek, biologists would install the weir at the same location identified for the trout reduction effort. For 45 days, from late March to mid-May, all large-bodied fish moving upstream would be captured in the weir (speckled dace would pass through). Captured fish would be removed, identified, measured, inspected for reproductive condition, and scanned for the presence of PIT tags. Native fish not previously tagged would be injected with PIT tags. Native species would be released above the weir. Trout would be euthanized and disposed of as previously described

ALTERNATIVES CONSIDERED AND DISMISSED

Chemical Removal

This alternative would eliminate trout in Bright Angel Creek by means of chemical euthanization. In the late fall, during the trout spawning period, as many native fish as possible would be removed from the entire length of the creek using backpack electrofishers and dip nets. The captured native fish would be kept alive in off-channel containers. Antimycin, a piscicide (agent to kill fish), would then be added to stream sections covering the length of Bright Angel Creek, thus destroying all remaining fish as it spread downstream. Potassium permanganate ($KmnO_4$) would be used to neutralize the toxicant before it entered the Colorado River. The fish carcasses would be collected using a block net, packed out by mule, and disposed of on the South Rim. The native fish held in off-channel containers would then be replaced into the creek, and some stocking of native fish species would be done to ensure population stability. Bright Angel Creek would be chemically treated only once. In subsequent years, a weir placed near the mouth of the creek would prevent additional trout from moving into the stream during their spawning period.

The use of antimycin (available commercially under the label Fintrol) was considered for this project because it has been used successfully in several national parks (e.g., Rocky Mountain National Park, Great Smoky Mountains National Park, Crater Lake National Park) as well as on numerous other federal lands. It has been shown to be an effective and largely environmentally benign[1] method to remove fish from streams for over 30 years. It was eliminated from detailed study in this assessment for the following reasons:

- Other national parks have closed the treated stream to recreational use for several days during application of antimycin. While this piscicide has not been shown to be harmful to humans, allowing public access to a creek containing a known toxicant and fish carcasses raises public health and aesthetic issues. Closing Bright Angel Creek would mean closing the North Kaibab Trail (the heavily used cross-canyon corridor of GRCA), two campgrounds, and possibly Phantom Ranch, a concession-operated lodge. This would be disruptive to park visitors and contracted concession operations. Not closing the trail between Roaring Springs and the Colorado River would present difficulties as well. The trail closely parallels Bright Angel Creek and ensuring that no one in that 9-mile reach approached the creek over the period of treatment would be a formidable task.

[1] Antimycin is an antibiotic that kills fish by inhibiting cellular respiration. It loses its toxicity quickly, within a few hours, leaving no residue. In both field and laboratory applications, it has had no short-term or long-term effects on other vertebrates (amphibians, reptiles, birds, mammals), phytoplankton (microscopic aquatic plants), or macrophytes (large aquatic plants). Antimycin has been shown to kill phytoplankton (microscopic fresh-water shrimp and shrimp-like organisms (e.g., *Gammarus*)) and aquatic insects, but populations of these organisms have recovered to pre-treatment or near pre-treatment levels within several (Grisak and Marotz 2003).

- Antimycin's efficacy in Bright Angel Creek is unclear. This piscicide loses effectiveness quickly in streams with high gradients, and is less effective in cold and alkaline waters (pH over 8.5). Bright Angel Creek is a relatively high-gradient stream; it is cold in the winter during the trout spawn; and its pH often exceeds 8.5. Tests would have to be performed to determine if antimycin would be effective in this environment.

- Use of a piscicide to effect removal of non-native fish would be a more intrusive, elaborate, and costly procedure than mechanical removal. It would directly affect more attributes of the Bright Angel Creek aquatic community, requiring more complex ecosystem monitoring before and after treatment to assess impact to macroinvertebrates and other resources.

Increased Angling

NPS rangers at Phantom Ranch report a substantial decrease in fishing in Bright Angel Creek over the last 10-15 years (Sjors 2004). Bag and size limits for trout at Bright Angel Creek were eliminated some years ago to encourage removal of trout, yet angling pressure remains low, with the annual number of fishermen ranging between 75 and 200 (Kassovic 2004). Interest has been so low, the concessioner at Phantom Ranch stopped selling fishing licenses six years ago (Streik 2004). Given the difficult access to the fishery (an arduous 14-mile round-trip hike or mule ride), limited availability of overnight accommodations, and the fact that no catch limits are imposed now, it is difficult to conceive of incentives that would increase angling to the point of substantially reducing trout populations.

Dewatering or Other Flow Modification

Bright Angel Creek is not a regulated stream. No means are available to modify stream flow to disadvantage non-native fish (e.g., dewater redds to expose and desiccate trout eggs).

Alternative Fish Barrier Structure

An alternative was considered that would divide Bright Angel Creek by means of a seasonal fish barrier. The upstream portion of the creek would be managed for native fish, and the downstream portion would be managed for trout. This alternative was rejected because maintaining a trout fishery and allowing trout to spawn in the lower reach of the creek would not meet one of the purposes of the proposed action to reduce mainstem trout populations to benefit endangered humpback chub and other native fish in the mainstem.

MITIGATION MEASURES

To minimize potential impacts on visitor experience, native fish, human safety, and other resources, the following measures would be implemented as part of the preferred alternative.

General Measures

- Biologists would be sensitive to public perception and be prepared to explain weir and electrofishing activities to any visitor who expresses interest.

- Care would be taken when entering and exiting the creek to minimize impact to streambanks and riparian vegetation and wildlife. Unvegetated, stony banks would be used whenever possible to minimize erosion.

- All project personnel would be familiar with and strictly adhere to research permit guidelines and limitations.

- The NPS will conduct discussions and consultations concerning this project with other agencies and tribes through multiple venues, including the Glen Canyon Dam Adaptive Management Program. Consultation under Section 106 of the NHPA concerning this project with all tribes will be completed before a decision is made concerning this project.

- If any cultural resources are discovered during the project, including any ethnographic resources/ traditional cultural properties, a park cultural resource specialist will be contacted immediately. All work in the immediate vicinity of the discovery will stop until the resources can be identified and documented and appropriate consultation and mitigation strategy is developed, if necessary, in accordance with the stipulations in the 1995 Programmatic Agreement among the NPS, the Arizona State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding the General Management Plan, Environmental Impact Statement, Grand Canyon National Park, Arizona.

Fish Handling Measures

To minimize stress and injury to fish, capture techniques would follow Ward (2002), including:

- Be respectful of all fish regardless of size and species.

- Minimize the time that fish are out of the water.

- Change water [in holding containers] frequently when fish must be held for more than a few minutes or if fish surface for air. Remember that handling stress increases as water temperature increases.

- No more than 8-10 fish in a holding container at one time.

- Watch straps, lapel badges and jewelry can damage fish.

- Do not hold fish tightly around the throat and avoid touching the gills.

- Rinse all sunscreen or lotions from hands prior to handling fish.

- Always wet hands and equipment such as nets and fish boards before use. Dry hands and equipment cause damage to fish skin by removing coatings that protect fish from disease. Equipment such as length boards and scales become hot in the sun and can damage fish if not wetted prior to use.

Electrofishing Measures

Electrofishing would be performed in a manner that minimizes harm to native fish and ensures the safety of project personnel and the public.

- All personnel involved in electrofishing would be trained in the safe and proper use of the backpack electrofisher to be used (e.g., Smith-Root LR24). The equipment would be kept in good working order, and all personnel would wear appropriate protective gear.

- A temporary sign would be posted at the reach being electrofished, warning people to stay out of the creek in that location (the electrical field extends only a few feet from the anode). The sign would include a brief explanation of the project.

- The minimum voltage would be used, sufficient to attract fish, but not enough to injure them. Biologists would observe the condition of captured fish. If signs of injury or handling stress are noted (dark bands on the body and longer recovery times), the settings for the electrofishing unit would be adjusted.

- Fish would be removed from the electrical field immediately. Each fish would be completely revived before releasing it into the live-well. Care would be taken not to crowd fish in the live-well, and holding time would be minimized. Trout would be kept separate from smaller, prey-sized native fish to avoid predation.

Other Measures

- In the unlikely event that a humpback chub (or even more unlikely, a razorback sucker) should be captured in the weir, it would be dealt with according to established protocols for handling endangered fish in Grand Canyon. If caught, individual endangered fish would be released into the creek upstream of the weir after being measured and PIT-tagged (if not already tagged).

- Project personnel would be instructed not to interact with California condors, bald eagles or osprey, and to immediately contact the appropriate Park staff if a condor, bald eagle or osprey appears in close proximity to project operations. If a condor, eagle or osprey is observed in the area, project personnel will note its behavior and report it to the Park biologist. Fish carcasses would be handled in such a way as not to attract condors, eagles or osprey.

- All project equipment (including personal gear like waders) would be cleaned prior to use to ensure that no invasive exotic species are introduced into the project area. Project personnel would be instructed to look for non-native New Zealand mudsnails in particular and to ensure that none are brought into the area or transported from one location to another.

CALIFORNIA CONDOR

- Prior to the start of the project, the park would contact personnel monitoring California condor locations and movement to determine condor status in or near the project.
- If a condor occurs at the project site, operations would cease until it leaves on its own or until permitted personnel employ techniques resulting in the condor leaving.
- Project workers and supervisors would be instructed to avoid interaction with condors and to contact the appropriate park or Peregrine Fund personnel immediately if and when condor(s) occur at the project site.
- The project site would be cleaned up at the end of each work day (i.e., trash disposed of, scrap materials picked up) to minimize the likelihood of condors visiting the site. Park condor staff may complete a site visit to ensure adequate clean-up measures.
- If condor nesting activity is known within 0.5 mile of the project area, then light and heavy construction would be restricted during the active nesting season, if viable nests persist. The

active nesting season is February 1 to October 15, or until young are fully fledged. These dates may be modified based on the most current information, in consultation with the park biologist and the USFWS.

BALD EAGLE

- Biologist and biological technicians will be instructed to refrain from interacting with any eagles that may be present
- If an eagle is observed in the area, biologists and technicians will notes its behavior and report it to the Park biologist.
- All fish will be disposed of in such a manner as to avoid creating an attractant to eagles.

HUMPBACK CHUB

- If any humpback chub or other listed fish species are encountered in the weir or as a result of electroshocking, all operations will cease and the Park will reinitiate consultation.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is determined by applying the criteria suggested in NEPA and further articulated in Council on Environmental Quality (CEQ) guidelines (1981). According to those guidelines, "the environmentally preferred alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101." That policy is to:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

- Assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;

- Attain the widest range of beneficial uses of the environment without degradation, risk of health of safety, or other undesirable and unintended consequences;

- Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;

- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and

- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative B (the preferred alternative) is also the environmentally preferred alternative. Overall, it more fully meets the above criteria than does Alternative A. Alternative B would meet the project's purpose and objectives to enhance the natural environment of the creek, resulting in beneficial impacts to GRCA's native aquatic resources in both Bright Angel Creek and the Colorado River. It is also expected to benefit a federally listed species, the endangered humpback chub, although at a minor or negligible level. Alternative A, on the other hand, would proliferate the unnatural aspects of the environment that Alternative B seeks to correct, creating adverse effects on the creek's environment and humpback chub.

Table 1. Comparative summary of environmental impacts.

Impact Topic	Alternative A - No Action	Alternative B – Mechanical Removal (Preferred Alternative)
Aquatic Resources	The fish assemblage in Bright Angel Creek would continue to be dominated by non-native species. Native fish in the creek would be adversely affected, directly by continued predation and indirectly by competition for food resources and possibly habitat. Impacts would be moderate, local, and long term. Impacts on native fish in the mainstem are likely to be minor, direct (predation) and indirect (competition), adverse, regional, and long term. The intensity of impact would likely be minor because the number of trout that spawn in the creek appears to be small compared to the total trout population in the mainstem.	A more natural native fish assemblage would be restored in Bright Angel Creek. These beneficial changes to the creek's natural aquatic ecosystem would be moderate, local, and long term (as long as the trout reduction program is in place). Impacts on non-native trout species in the creek would be moderate (not "major" because the impact would be largely local) and adverse. Impacts to native fish in the mainstem are expected to be minor, direct and indirect, beneficial, and regional. Impacts to non-native trout in the mainstem would be minor, direct, adverse, and regional. The duration of these effects would depend on the duration of the action. The potential impact from capturing (handling and electrofishing) native fish would be negligible, direct, adverse, local, and short term. Utilization of appropriate fish handling and electrofishing protocols would mitigate potential adverse impacts.
Special Status Species		
Humpback Chub	Current levels of predation by and competition with trout would continue, resulting in minor, direct, adverse, regional, and long-term impact.	Fewer trout would be present in the Colorado River system to compete with and prey on humpback chub, resulting in a minor, indirect, beneficial, and regional impact on the species. The duration of the impact would depend on the duration of the action. The potential effect of capturing a humpback chub in the weir would be negligible, direct, adverse, local, and short term. Utilization of appropriate fish handling protocols would mitigate potential adverse impacts.
Razorback Sucker	No effect or, at most, a negligible adverse effect because individuals are unlikely to be present.	It is unlikely that this species would benefit by a reduction in trout in the Bright Angel Creek area because individuals are unlikely to be present. The remote possibility of capturing a razorback sucker in the weir would result in negligible, direct, adverse, local, and short-term impacts on the species. Utilization of appropriate fish handling protocols would mitigate potential impacts.
Flannelmouth Sucker	Impacts would be the same as for humpback chub except more young flannelmouth suckers would be present in and near Bright Angel Creek and would therefore be more vulnerable to predation by trout in that area.	Impacts would be the same as for humpback chub except young flannelmouth suckers are more likely to be present in and near Bright Angel Creek and would likely receive more beneficial effects from trout removal in that area.
Northern Leopard Frog	Trout may compete with and prey on northern leopard frogs if the frogs occur in the Bright Angel Creek drainage. Given the uncertainty of the frog's presence, the low population number if the frog is present, and the lack of information about possible predation by trout, this alternative is likely to have no effect or, at most, a negligible, direct, adverse, local, and short-term effect.	If this species is present in Bright Angel Creek, the reduction of trout may benefit them indirectly by increasing the availability of food and reducing predation pressure. Effects would be negligible. The duration of impact would depend on the duration of the action. The impact of electrofishing would likely be negligible, direct, adverse, local, and short term.

Bald Eagle	Availability of trout for food in Bright Angel Creek and the mainstem would remain at current levels, resulting in minor, indirect, beneficial, regional, long-term impact.	The reduction of spawning trout in Bright Angel Creek would reduce food availability for bald eagles at that location, eventually causing any eagles who frequent the area to relocate. The effects would be minor, indirect, adverse, and local. The duration of impact would depend on the duration of the action. The reduction in food availability for bald eagles in the mainstem is expected to be negligible.
Osprey	Same as for bald eagle.	Same as for bald eagle.
Visitor Experience	No effect. Angling in Bright Angel Creek would still be available as a recreational opportunity in GRCA.	The quality of recreational fishing in Bright Angel Creek would diminish, reducing recreational opportunities at GRCA by a small degree. Few visitors to the Park would be aware of the loss of the fishery. The impacts to visitor experience at GRCA would therefore be minor, indirect, adverse, and local. The duration of the impact would depend on the duration of the action but is likely to be long term. Impacts on the aesthetic qualities of Bright Angel Creek and intrusions to visitor experience from project operations would be negligible, direct, adverse, and short term.

Table 2. Summary of Alternatives and Extent to Which Each Alternative Meets Project Objectives	
Alternative A – No Action	**Alternative B – Mechanical Removal (Preferred Alternative)**
Trout from the mainstem Colorado River would continue to be allowed to spawn in Bright Angel Creek without human interference.	Trout would be mechanically removed from Bright Angel Creek using 1) a weir to capture them as they move upstream into the creek to spawn, and 2) electrofishing and dip netting to capture additional trout in the stream during monitoring of fish populations.
Objective 1: Benefit the endangered humpback chub and other native fish species in the mainstem Colorado River.	
Alternative A: Does not meet objective, as it would continue to allow trout to spawn in the creek and serve as predators to native fish in the creek and river.	**Alternative B:** Meets the objective by mechanically reducing the number of the non-native predator species, and by not allowing the non-native species to spawn in the creek and move into the river where they can serve as predators on the native species.
Objective 2: Restore and enhance, to the extent possible, the native fish community that once flourished in Bright Angel Creek.	
Alternative A: Does not meet objective, as non-native fish will continue to spawn and impact the creek ecosystem.	**Alternative B:** Meets objective, taking steps to reduce the non-native fish in the creek, through mechanical removal, and to impede their ability to spawn in the creek.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter describes the present condition (i.e., affected environment) within the project area and the changes (i.e., environmental consequences) that can be expected from implementing the proposed action or taking no action at this time. The No-Action Alternative (Alternative A) sets the environmental baseline for comparing the effects of the proposed action. The environmental effects, or changes from the baseline condition, described in this chapter are organized by relevant issue, or impact topic. Impact topics define the scope of the environmental concerns for the proposed action; in this case the impact topics identified during scoping are Aquatic Resources, Special Status Species, Cultural Resources and Visitor Experience (see Chapter 1).

METHODOLOGY

The analysis of issues that have been determined relevant and the corresponding conclusions found in this chapter are based on information obtained through park staff knowledge of the resources and site, review of existing literature and park archives, and professional judgment. As required by NEPA regulations, potential impacts associated with an implemented action are described in terms of type (direct, indirect, beneficial, adverse), context (site-specific, local, state, or regional), intensity (negligible, minor, moderate, or major), and duration (short-term, lasting less than 5 years, or long-term, lasting more than 5 years). Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this EA. NEPA regulations also require an evaluation of cumulative impacts, and NPS policy requires an evaluation of potential "impairment" of park resources.

CUMULATIVE IMPACT DEFINITION AND POTENTIAL CONTRIBUTING PROJECTS

Cumulative impact is defined as the impact that results from the incremental effects of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions, taking place over a period of time (40 CFR 1508.7). Other past, ongoing, or foreseeable future actions that could impact Bright Angel Creek's aquatic community or trout populations in the Colorado River are described below.

Tamarisk Management and Tributary Restoration. NPS crews are removing tamarisk (*Tamarix* sp.) and other non-native plants from along Bright Angel Creek as part of the Park's ongoing Tamarisk Management and Tributary Restoration Project (Makarick 2004). The purpose of the project is to restore more natural conditions in the Park's side canyons and to prevent any further loss or degradation of the existing native animal and plant life by halting the spread of this highly invasive exotic plant (GRCA 2002a). Eradication methods include manual removal, herbicide lance injection, hack and squirt, cut stump, and basal barks herbicide application (see GRCA 2002a for an explanation of these procedures). Seeding of native plant species will follow the removal effort. Because of the invasive characteristics of tamarisk, and a nearby source of new incursions (tamarisk is well established in the mainstem canyon), it is likely that repeated treatments will be needed over time.

Removing tamarisk may result in a short-term increase in sedimentation (turbidity) in Bright Angel Creek due to an increase in soil erosion along the banks of the creek during the period when the tamarisk have

been removed and the new native seeds are taking hold (Makarick 2004). Stream flow may increase slightly over the long term due to a reduction in water consumption by tamarisk. The Tamarisk Management and Tributary Restoration Project underwent NEPA analysis in 2002 (GRCA 2002a), which resulted in a Finding of No Significant Impact (GRCA 2002b).

Upgrade Corridor Area Fire Protection. Construction activities are taking place in Bright Angel Canyon as GRCA upgrades the existing water distribution system connected to the transcanyon pipeline. Fire protection systems are being added to several structures at Roaring Springs, Cottonwood Camp, and Phantom Ranch to diminish the risk of loss from structural fires. Construction activities include some trenching in the Phantom Ranch area. No impacts to Bright Angel Creek are anticipated (GRCA 2003a). The Upgrade Corridor Area Fire Protection project underwent NEPA analysis in 2003 (GRCA 2003a), which resulted in a Finding of No Significant Impact (GRCA 2003b).

Diversions from Roaring Springs for Consumptive Use. Since 1967, water has been diverted from Bright Angel Creek flow (specifically Roaring Springs) to meet the consumptive needs of developed areas in GRCA. This water is delivered to the North Rim, Phantom Ranch, Indian Garden, and the South Rim by way of the transcanyon pipeline. In 2002, the U.S. Bureau of Reclamation (USBR) estimated that a maximum flow of 1.74 cubic feet per second (cfs)[2] was diverted to meet park water demands (USBR 2002). That depletion represents approximately 5% of Bright Angel Creek's mean annual flow of 35 cfs. Discharge in the creek is highly variable, however, so the percentage of diverted flow also varies, amounting to less than 0.4% of discharge for the highest-flow month on record (i.e., 501 cfs in May 1941) and more than 13% for the lowest-flow month on record (i.e., 13.2 cfs in July 1972) (Slack et al. 1993). Using baseline data from 1999, a water supply appraisal completed in 2002 predicted that water use in the Park could double by the year 2050 (USBR 2002). Depletions from Roaring Springs may increase in line with these long-term projections; however, changes in demand over short periods is difficult to predict. Visitation to GRCA increased by over 700% between 1949 and 1999, but growth is not necessarily linear. Visitation actually decreased by over 9% between 1999 and 2003 (NPS data). No significant increase in water diversion from Bright Angel Creek is planned at this time.

The effects of the ongoing depletion of streamflow on Bright Angel Creek's aquatic ecosystem vary, with the potential for impact greatest when runoff is low. Reduced flow results in reduced stream width, velocity, and depth, and increased water temperature and specific conductivity. An instream flow habitat simulation model run in 1984 indicated that an increase in depletion of up to 30% would have no substantial adverse effects on aquatic insects and fish in the creek (Usher et al. 1984).

Grand Canyon Monitoring and Research Center Trout Reduction Efforts. In January 2003, GCMRC began implementing a science plan consisting of 2 years of experimental releases from Glen Canyon Dam combined with mechanical removal of trout from a 9.5-mile reach of the Colorado River (GCMRC 2003a). One of the purposes of the plan is to improve survival and recruitment in juvenile humpback chub by reducing non-native trout populations in the river. The experimental dam-release scenarios include non-native fish suppression flows in January-March 2003 and 2004. These high daily fluctuating flows (5,000-20,000 cfs) are designed to disrupt trout reproductive activities in the mainstem, desiccate eggs and fry, and displace fingerlings. The second component, mechanical removal, calls for removing trout by electrofishing between River Mile (RM) 56.2 and RM 65.7, near the LCR confluence. Removal efforts consist of six depletion trips each year, three in January-March and three in July-September (Coggins and Yard 2003). Current plans call for a total of 24 depletion trips over 4 years (2003-2006). In the three trips conducted in January-March 2003, biologists report removing 6,703

[2] The estimated 1.74 cfs comprises 1.56 cfs for the South Rim, 0.16 cfs for the North Rim, and 0.02 cfs for Phantom Ranch. (USBR 2002).

rainbow trout and 130 brown trout in 355 hours of electrofishing (Coggins and Yard 2003). It is premature at this point to evaluate the effects of the effort. The combined program of dam releases and trout removal underwent NEPA analysis in 2002, which resulted in a Finding of No Significant Impact (DOI 2002).

Feasibility Study to Determine the Efficacy of Using a Weir in Bright Angel Creek to Capture Brown Trout. In November 2002-January 2003, a study was conducted to test the effectiveness of using a weir in Bright Angel Creek to capture spawning trout. The study was performed by biologists from SWCA Environmental Consultants under contract to the NPS. During the 64 days of weir operation, 423 brown trout were captured and sacrificed, and 188 rainbow trout were captured and released above the weir (SWCA 2003). It is believed that the majority of the brown trout attempting to spawn in Bright Angel Creek that winter were intercepted, resulting in a major impact on the aquatic fauna in Bright Angel Creek, at least for the short term. The long-term and regional (mainstem) effects are more difficult to assess.

Restoring Native Fish Habitat in Grand Canyon National Park. In February 2004, GRCA initiated a 2-year feasibility study for non-native fish control in key tributaries (initially Shinumo, Tapeats, and Kanab Creeks) in GRCA. The goal of the project is to determine the potential for restoring native fish populations in these streams. Two winter trips are being conducted each year (2004-2005) to survey for species composition, distribution, and abundance, and to remove the non-native fish captured during the sampling. Abundance estimates will be used to assess the efficiency of non-native fish removal and to assess the short- and long-term reinvasion rate of non-native fish. The resulting information will form the basis of a management plan for controlling non-native fishes in these, and possibly other, tributaries.

IMPAIRMENT OF PARK RESOURCES OR VALUES

The following is quoted from the National Park Service's Upgrade Corridor Area Fire Protection Environmental Assessment (GRCA 2003a):

> *In addition to determining the environmental consequences of implementing the alternatives, National Park Service policy (Management Policies 2001, §1.4.4) requires analysis of potential effects to determine whether actions would impair park resources.*
>
> *The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:*

- *necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;*
- *key to the natural or cultural integrity of the park; or*
- *Identified as a goal in the park's general management plan or other relevant NPS planning documents.*

Impairment could result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The potential for impairment is discussed in the Conclusion section at the end of each impact topic in Chapter 3.

Section 106 of the National Historic Preservation Act

In this environmental assessment/assessment of effect, impacts to cultural resources are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the Council on Environmental Quality (CEQ) that implement the National Environmental Policy Act (NEPA). These impact analyses are intended, however, to comply with the requirements of both NEPA and §106 of the National Historic Preservation Act (NHPA). In accordance with the Advisory Council on Historic Preservation's regulations implementing §106 of the NHPA (36 CFR Part 800, Protection of Historic Properties), impacts to historic properties and ethnographic resources were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that were either listed in or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the National Register; and (4) considering ways to avoid, minimize or mitigate adverse effects.

Under the Advisory Council's regulations a determination of either adverse effect or no adverse effect must also be made for affected National Register eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualify it for inclusion in the National Register (e.g. diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance or be cumulative (36 CFR Part 800.5, Assessment of Adverse Effects). A determination of no adverse effect means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the National Register.

PROJECT AREA

The proposed project area encompasses Bright Angel Creek and environs in GRCA, Coconino County, Arizona (Figure 1). The mouth of the creek is at Latitude 36°06'11", Longitude 112°05'44". A perennial stream, Bright Angel Creek originates on the North Rim, drains an area of 101 sq mi, and flows approximately 17.6 mi before converging with the Colorado River (Slack et al. 1993, Otis 1994). About 9 mi upstream of the confluence, a 9-ft waterfall acts as a barrier to upstream movement of fish. Stream flow is contributed by: (a) numerous springs, with Angel and Roaring Springs being the largest; (b) four perennial tributaries (Phantom, Ribbon, Wall, and Transept Creeks); and (c) one intermittent tributary (Manzanita Creek). Discharge averaged 35 cfs over the 50-year period of record (1924-1973) at a U.S. Geological Survey (USGS) stream gauge (USGS 2004). Measurements of discharge taken by park hydrologists in 1992-1994 averaged 27.8 cfs (GRCA 1994). Elevation of the creek ranges from over

8,000 ft on the North Rim; 5,200 ft at Roaring Springs; 4,400 ft at the barrier waterfall; to 2,400 ft at the mouth. Bright Angel Creek is considered a moderately high-gradient stream, dropping an average of 421 ft/mi (Slack et al. 1993). Substrate is heterogeneous, ranging from boulders to silt; however, boulders, cobbles, and gravel dominate (Otis 1994). Water quality is dolomitic, with high levels of calcium and magnesium and low levels of sulfate. Riparian biotic communities, dominated by cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), tamarisk (*Tamarix ramosissima*), and baccharis (*Baccharis* spp.), are found along the creek banks.

Most activities related to the proposed action would take place in the Phantom Ranch area, near the confluence of Bright Angel Creek and the Colorado River. This area is located within the popular Cross-Canyon Corridor, a trail system that links the developed area on the South Rim with the developed area on the North Rim. Access from either rim is difficult, requiring a descent by foot or mule of approximately 5,000 ft elevation change from the South Rim and nearly 6,000 ft from the North Rim. The shortest route, the South Kaibab Trail, is about 6.5 miles long. The North Kaibab Trail is about 14 miles long. Facilities in the Phantom Ranch area include a concession-operated lodge, an NPS campground (Bright Angel), a ranger station, sewage treatment plant and various support facilities. Together the campground and the lodge can accommodate approximately 170 over-night visitors. A second campground (Cottonwood) is located 7 miles north up Bright Angel Canyon from Phantom Ranch.

In addition to Bright Angel Creek, the area of potential impact includes the reach of Colorado River within the range of individual fish that also occupy (or could potentially occupy) Bright Angel Creek. The delimitations of this reach are not known with any precision, but brown trout and flannelmouth sucker, for example, are known to move many miles in a relatively short time, often as a function of spawning activity (Valdez and Carothers 1998). It is likely that at least some of the brown trout that frequent the LCR inflow area (RM 57.0–RM 65.4; Valdez and Ryel 1994) spawn in Bright Angel Creek; therefore, the area of potential effect in the Colorado River is here defined as 30 mi upstream and 30 mi downstream of Bright Angel Creek. One of the nine tagged brown trout that were caught in Bright Angel creek during the feasibility study was tagged in the mainstem above the Little Colorado River (SWCA 2003).

AQUATIC RESOURCES

Affected Environment

The aquatic ecosystem of Bright Angel Creek and the Colorado River includes various microscopic organisms, diatoms (small attached algae), *Cladophora* (large filamentous green algae), aquatic macroinvertebrates (e.g., midges, blackflies, snails, worms), and fish. Algae are primary producers at the base of the aquatic food web, which means they use the energy from sunlight to convert carbon dioxide to organic matter (photosynthesis). Primary producers are a source of food for aquatic macroinvertebrates and fish, and macroinvertebrates are a food source for fish. Brown and rainbow trout also consume small fish as part of their diet. The proportion of algae, aquatic plants, macroinvertebrates, fish, and miscellaneous food stuffs and debris that make up a fish's typical diet varies by species, food availability, and other factors. Significant impacts to food web structure can occur when top predators, like brown trout, are removed, or when the abundance of fish changes substantially.

Native Fish

The three native fish typically found in Bright Angel Creek are speckled dace, bluehead sucker, and flannelmouth sucker. All three species currently share that habitat with non-native species, primarily brown and rainbow trout. The flannelmouth sucker is described in the "Special Status Species" section; humpback chub, a native species found in the mainstem and the LCR, is also described in the "Special Status Species" section. Speckled dace and bluehead sucker are described below.

Speckled Dace. This is a small (up to 4 inches), short-lived species found in the Colorado River and in tributaries in GRCA. This species is widely distributed and reported as locally abundant in the upper reaches of the Colorado River, particularly in tributary mouths (Valdez and Carothers 1998). Minckley (1978) reported them from all tributaries he investigated but found that the distribution was "essentially the reverse of large rainbow trout." In one year of monthly sampling in Bright Angel Creek (May 1976 through June 1977), Minckley reported speckled dace to be the most common species captured (n=246, or 54% of total). Some evidence suggests a marked decline in speckled dace abundance in the creek since the 1970s. Otis (1994) recorded very few of these fish during the same months when Minckley reported the highest abundances (March-September). Otis captured only 13 individuals in over 1,000 trap-hours.

Some speckled dace inhabit tributaries year-round, apparently taking shelter under substrate through the winter. Others move into the mainstem in the winter, possibly to avoid large aggregations of spawning trout (Minckley 1978, Valdez and Carothers 1998). Its preferred habitat is fast moving water over rocky substrate. Spawning occurs in tributaries and possibly the mainstem, primarily in April-May. Their diet consists of algae, organic detritus, and small macroinvertebrates (Valdez and Carothers 1998). The small size of this fish makes it vulnerable to predation even as an adult.

Bluehead Sucker. Bluehead suckers are generally large (up to 17 inches), long-lived fish. They are widely distributed in GRCA but occur only in small numbers. During 1976-1977, bluehead suckers accounted for only 7% (n=32) of fish captured in Bright Angel Creek (Minckley 1978). Otis (1994) observed five adult and small numbers of larval bluehead suckers in 1992-1993. These fish reside in fast moving water over a rocky substrate throughout the Colorado River system. They occupy mainstem habitats in GRCA but are more abundant in tributaries and tributary inflow areas. Spawning usually occurs from early spring through early summer (primarily April-May) in GRCA tributaries, including Bright Angel Creek (Minckley 1978, Otis 1994). The bluehead sucker is an omnivorous benthic (bottom) feeder, scraping diatoms, algae, aquatic invertebrates, and detritus from rocky substrate (Valdez and Carothers 1998). Larval and juvenile bluehead suckers are vulnerable to predation by trout.

Non-native Fish

Recent studies indicated that two introduced species are common in Bright Angel Creek: brown trout and rainbow trout (Otis 1994). Brook trout, cutthroat trout, and cutthroat hybrids have been reported in the past as well. In Grand Canyon, trout are found in the mainstem Colorado River and in several cold-water tributaries. Based on annual monitoring data, trout populations in the system are estimated to have increased four- to six-fold in the last decade (GCMRC data cited in USFWS 2002b). Negative interactions between trout and native fish species include predation and competition. Predation by brown and rainbow trout has been well documented (see below).

Competition for resources, including food and habitat (space), is more difficult to document, but dietary and habitat overlap does exist between trout and native fish, particularly humpback chub (Valdez and Carothers 1998). The overwhelming biomass of trout in the Colorado River may exhaust resources and crowd out native fish in some habitats.

Brown Trout. Brown trout are a large salmonid species (can exceed 20 inches) generally associated with cold water habitats. In GRCA, they reside year-round in both the mainstem Colorado River and in tributaries, including Bright Angel Creek. The mainstem population is more restricted in distribution than rainbow trout, occurring primarily between the RM 62.5 (the LCR) and RM 150, with the largest numbers near the Bright Angel Creek inflow (Valdez and Ryel 1995, Speas et al. 2003). A recent study estimates their mainstem population at 84,000 individuals (Speas et al. 2003). Spawning usually occurs in fall to early winter. Brown trout prefer to spawn in streams and tributaries, so mainstem reproduction is unlikely. Bright Angel Creek is believed to be the primary spawning grounds for brown trout in GRCA, although individuals in reproductive condition have been captured in other tributaries, including nearby Clear Creek (Valdez and Carothers 1998). The proportion of the total adult brown trout population that spawns in Bright Angel Creek is unknown, but 423 brown trout were captured in the Bright Angel Creek weir during their spawning run in 2003.

Aquatic invertebrates usually make up the majority of the food base for brown trout, but these fish also consume terrestrial invertebrates, small fish, fish eggs, and *Cladophora* (Carothers and Minckley 1981, Marsh and Douglas 1997). Compared to rainbow trout, brown trout are more piscivorous (Valdez and Carothers 1998). Valdez and Ryel (1995) found fish in over 18% of brown trout stomachs in mainstem sampling, and Marsh and Douglas (1997) found fish in 20% of brown trout stomachs from the LCR. Valdez and Ryel (1995) estimated that 10,000 adult brown trout could reasonably consume 759,200 subadult humpback chub annually.

Brown trout dominate the fish assemblage in Bright Angel Creek (Otis 1994). This is a fairly recent development. In 1976-1977, brown trout accounted for only 0.4% of fish captured in Bright Angel Creek, while rainbow trout accounted for 39% (Minckley 1978). The remaining fish captured were native species. In 1992-1993, brown trout accounted for 81% streamwide (Otis 1994). Concurrently, the abundance of native speckled dace in Bright Angel Creek declined from common in the 1970s to rare in the 1990s (Otis 1994). Thus, there is a positive correlation between the decline in abundance of native speckled dace in Bright Angel Creek and the increased dominance of piscivorous brown trout. In the mainstem Colorado River, predation by brown trout on the endangered humpback chub is a major management concern. Predation by brown trout has been documented, and brown trout numbers are increasing in the reach of river where humpback chub are most abundant (Valdez and Ryel 1995).

Rainbow Trout. Rainbow trout are a large salmonid species (can exceed 20 inches) that prefer swift cool water over a silt-free rocky substrate. Like brown trout, rainbow trout are residents of both the mainstem Colorado River and suitable tributaries. Spawning usually occurs between late fall and early spring, peaking in December-January. Rainbow trout reproduce in the mainstem Colorado River and in several cold-water tributaries, including Bright Angel Creek. The proportion of the total rainbow trout population that spawn in Bright Angel Creek is unknown, but the fact that only 188 rainbow trout were captured in the Bright Angel Creek weir in November to mid-January 2003 indicates that the percentage is likely small. In the Colorado River system the rainbow trout diet includes *Cladophora* and diatoms, aquatic invertebrates, terrestrial invertebrates, fish, and fish eggs (Valdez and Carothers 1998). GRCA rainbow trout are notable for the high occurrence of *Cladophora* in their diet.

Rainbow trout is the overwhelmingly dominant fish species in the Colorado River system in GRCA, with population estimates between RM 39 and RM 196 of 369,000 individuals (Speas et al. 2003). Like brown trout, rainbow trout are known predators on native fishes (Minckley 1978, Carothers and Minckley 1981, Maddux et al. 1987, Marsh and Douglas 1997). While their rate of predation is generally much lower than that of brown trout, their population size is more than four times greater, magnifying the impact. Rainbow trout are opportunistic omnivores (Haden 1992). Rates of predation (measured by the occurrence of fish in stomach samples) range from 0.6% in the mainstem (Valdez and Ryel 1995) to 16% in the LCR (Marsh and Douglas 1997). Under certain conditions, their predation rate can be much higher. In 1970, the diet of rainbow trout sampled near Lees Ferry was 66% fish in February and 79% in March (Rathburn 1969). The impact of rainbow trout on the native fish community, whether by predation or competition, has been documented in Grand Canyon and elsewhere. Speckled dace disappeared from Tapeats Creek after rainbow trout were introduced (Miller and Smith 1975). Speckled dace disappeared in the fall in Bright Angel Creek due to the presence of spawning rainbow trout (Minckley 1978). In Nutrioso Creek in eastern Arizona, predation by rainbow trout on the native Little Colorado spinedace was high even in the presence of abundant macroinvertebrate prey (Blinn et al. 1993). Researchers found an average of 0.7 spinedace per rainbow trout stomach sampled, and one trout was observed to consume four spinedace in 16 hours.

Environmental Consequences

Methodology

The thresholds of change for the intensity of impact on aquatic resources are defined as follows:

Negligible: Aquatic resources would not be affected or the effects would be at or below the level of detection. Changes would be so slight that they would not be measurable or of perceptible consequence to aquatic resources.

Minor: Effects to aquatic resources would be detectable. Effects would be localized and short term. There would be little consequence to individuals or populations. Changes to habitat would be short term and localized.

Moderate: Effects to aquatic resources would be readily detectable, localized, and long term, or larger scale for short term. There would be consequences to populations.

Major: Effects to aquatic resources would be obvious, long term, and regional. Substantial consequences to populations would occur.

Alternative A – No Action

Under this alternative current conditions and trends in species composition, distribution, and abundances of aquatic organisms in Bright Angel Creek and adjacent reaches of the Colorado River would continue. Non-native trout, particularly brown trout, would continue to dominate the fish assemblage in Bright Angel Creek. This would disadvantage native fish in the creek directly by continued predation and indirectly by competition for food resources and possibly habitat. The native food web structure (including native organisms other than fish) in the aquatic ecosystem would continue to be impacted by the dominance of the non-native species. These adverse impacts would be moderate in intensity, local in context, and long term in duration.

Trout spawned in the creek would continue to contribute to predation and competition pressures on native fish in the mainstem. Effects would be minor, direct (predation) and indirect (competition), adverse, regional, and long term. The intensity of impact would likely be minor because the number of trout that spawn in the creek appears to be small compared to the total trout population in the river (i.e., within 30 mi both upstream and downstream of the Bright Angel Creek inflow).

There would be no removal of non-native species (i.e., trout), so no adverse impacts to those species.

Cumulative Impacts

The combined past, present, and future non-native trout reduction programs in GRCA may result in a moderate, indirect, beneficial, and regional effects on native fish in the Colorado River. Most of that impact would be attributable to dam operations, which have the potential to disrupt trout spawning on a broad scale, and to mechanical trout removal in the mainstem by GCMRC. The impact of dam operations is unknown at this time, but GCMRC's trout reduction program succeeded in removing 6,833 trout from the mainstem in 2003. This compares to 611 trout caught in the weir at Bright Angel Creek, also in 2003. Potential adverse cumulative effects of handling native fish would be negligible because uniform protocols would be applied in all actions to minimize stress and injury to individual fish. These impacts would be local and short term. Ongoing water diversions for consumptive use, tamarisk removal, and current construction work in Bright Angel Canyon are not expected to contribute significantly to cumulative impacts on aquatic resources addressed in this EA.

Alternative B – Mechanical Removal (Preferred Alternative)

Substantially reducing the population of brown and rainbow trout in Bright Angel Creek would affect the food base in the stream. Brown trout consume large numbers of macroinvertebrates. Removing that predatory species is expected to result in an increase in macroinvertebrate populations, including aquatic insects like midges and blackflies (Townsend 1996). Due to an increase in macroinvertebrates that graze on algae, the abundance of algae and macrophytes (aquatic plants) would likely decrease, at least in the short term.

Under this alternative, the abundance of non-native brown and rainbow trout in Bright Angel Creek would decrease significantly. Based upon the 2002 feasibility study and 2006 population study (SWCA 2002 and 2006), several hundred non-native trout may be removed annually (a moderate intensity adverse impact on those species because impacts would be largely local, and affect a very small percentage of the trout population in the Colorado River; also see discussion of cumulative impacts for Alternative B below). The reduction of spawning trout in the winter would be noticeable immediately. The resident populations of trout in the upstream reaches of the creek would be reduced more gradually with repeated electrofishing operations. In the absence of predation and competition from trout, populations of resident native fish (speckled dace and bluehead suckers) are expected to increase over time. Eventually, native fish species would once again dominate the Bright Angel Creek aquatic environment, and other components of the system (primary producers and macroinvertebrates) would adjust to the evolving changes. Impacts on Bright Angel Creek's natural ecosystem values, including native fish species, would be moderate, direct and indirect, beneficial, and local. Impacts on non-native trout species would be moderate (because the impact would be largely local) and adverse. The duration of the impact would depend on the duration of the action. If the trout reduction program is terminated, non-native trout would eventually re-invade from the mainstem, and the system would revert to existing conditions.

With the reduction of trout spawning in Bright Angel Creek, predation and competition pressures would be reduced on native fish in the mainstem, including the young bluehead suckers and flannelmouth suckers spawned in Bright Angel Creek. With fewer trout in the inflow area and for several miles upstream and downstream, early life stages of these fish (from eggs to juveniles) should have an increased survival rate. (See also discussions of effects on humpback chub and flannelmouth sucker in the "Special Status Species" section below.) Impacts to native fish in the mainstem are expected to be minor, direct (predation) and indirect (competition), beneficial, and regional. The duration of the impact would depend on the duration of the action.

Bluehead suckers would be captured, processed (measured and tagged), and released at the weir during the spring spawning run. They are also likely to be captured by electrofishing during the population surveys. To minimize potential stress and injury to the fish from either handling or electrofishing, established protocols would be followed (see fish handling and electrofishing procedures in the "Mitigation Measures" section of Chapter 2). The potential impact from handling bluehead suckers (and any other large native fish) would be negligible, direct, adverse, local, and short term.

Cumulative Impacts

The combined past, present, and future non-native trout reduction programs in GRCA may result in a moderate, indirect, beneficial, and regional effects on native fish in the Colorado River. Most of that impact would be attributable to dam operations, which have the potential to disrupt trout spawning on a broad scale, and to mechanical trout removal in the mainstem by GCMRC. The impact of dam operations is unknown at this time, but GCMRC's trout reduction program succeeded in removing 6,833 trout from the mainstem in 2003. This compares to 611 trout caught in the weir at Bright Angel Creek, also in 2003. Potential adverse cumulative effects of handling native fish would be negligible because uniform protocols would be applied in all actions to minimize stress and injury to individual fish. These impacts would be local and short term. Ongoing water diversions for consumptive use, tamarisk removal, and current construction work in Bright Angel Canyon are not expected to contribute significantly to cumulative impacts on aquatic resources addressed in this EA.

Conclusions

Alternative A - No Action. Under this alternative, the fish assemblage in Bright Angel Creek would continue to be dominated by non-native species, particularly brown trout. Allowing trout to continue to spawn in Bright Angel Creek and to dominate the creek's ecosystem is expected to adversely affect native fish in the creek, directly by continued predation and indirectly by competition for food resources and possibly habitat. These adverse impacts would be moderate, local, and long term. Impacts on native fish in the mainstem are likely to be minor, direct (predation) and indirect (competition), adverse, regional, and long term. The intensity of impact would likely be minor because the number of trout that spawn in the creek appears to be small compared to the total trout population in the area.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

Alternative B – Mechanical Removal (Preferred Alternative). This alternative is expected to restore more natural abundances of native fish species (particularly speckled dace and bluehead sucker) in Bright Angel Creek. These beneficial changes to the creek's natural aquatic ecosystem would be moderate in

intensity (i.e., readily detectable, localized, and long term as long as the trout reduction program is in place). The effects on non-native trout in Bright Angel Creek would be moderate (because local) and adverse. Impacts to native fish in the mainstem are expected to be minor, direct (predation) and indirect (competition), beneficial, and regional. Impacts to non-native trout in the mainstem would be minor, adverse, and regional. The duration of the impact would depend on the duration of the action. The potential impact from capturing bluehead suckers (and any other large native fish) would be negligible, direct, adverse, local, and short term.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

SPECIAL STATUS SPECIES

Affected Environment

Six special status species either are known to occur or may occur in the project area and have the potential to be affected by the proposed action (Table 3).

Table 3. Special status species either known to occur or may occur in the project area and have the potential to be affected by the proposed action.

Common Name	Scientific Name	Status	Project Vicinity Occurrence
Humpback chub	*Gila cypha*	E, WSCA	Occurs in the Colorado River, including the Bright Angel Creek inflow area. May occur in Bright Angel Creek.
Razorback sucker	*Xyrauchen texanus*	E, WSCA	May occur in the Colorado River and in Bright Angel Creek. May be extirpated.
Flannelmouth sucker	*Catostomus latipinnis*	SC	Occurs in the Colorado River. Spawns in Bright Angel Creek in the spring.
Northern leopard frog	*Rana pipiens*	WSCA	May occur in Bright Angel Canyon.
Bald eagle	*Haliaeetus leucocephalus*	T	In winter, forages along the Colorado River and tributaries, including Bright Angel Creek.
Osprey	*Pandion haliaetus*	WSCA	In winter, forages along the Colorado River and tributaries, including Bright Angel Creek.

Key: E = federally listed as endangered under the Endangered Species Act (ESA); T = federally listed as threatened under the ESA; SC = not federally or state listed but considered a Species of Concern by the USFWS; WSCA = listed as Wildlife of Special Concern in Arizona by the AGFD.

Humpback Chub

The humpback chub was federally listed as endangered in 1967 (32 FR 4001), with critical habitat designated in 1994 (59 FR 13374). In Grand Canyon, critical habitat extends from about RM 35 to about RM 209. This species is also listed as WSCA. Ten aggregations have been identified in Grand Canyon (Valdez and Ryel 1995). The two largest are in the LCR and in the mainstem near the LCR inflow (RM 57.0-65.4). A small aggregation is located in the Bright Angel Creek inflow area (RM 83.8-92.2). Only one humpback chub record exists for Bright Angel Creek ("near Phantom Ranch"), but Miller (1946)

presumed the fish was caught in the Colorado River at or near the mouth of Bright Angel Creek. Population estimates made in 2001-2002 for the humpback chub aggregations in and near the LCR indicate a significant decline in numbers over the last decade (Van Haverbeke and Coggins 2003, Van Haverbeke 2003). GCMRC biologists (2003b) have estimated that the current spawning population is probably somewhere between 2,000 and 4,000 age-4 and older fish, possibly a 50% decline since 1990. Cited threats to the species include habitat modification, predation by and competition with non-native fish species, and parasitic infestation (GCMRC 2003b). Adult humpback chub can reach 20 inches in length, and are unlikely to be preyed upon by trout; however, emergent fry, young-of-year, and juvenile chub are susceptible to predation in the LCR and the mainstem.

Humpback chub inhabit the Colorado River and its larger tributaries in canyon-bound reaches characterized by deep, swift currents and rocky substrates. Larvae and juvenile fish prefer shallow, low-velocity nearshore habitats. In Grand Canyon, most humpback chub spawn in the LCR in the spring (March-May). Diet consists primarily of aquatic insects, *Gammarus* (freshwater shrimp), *Cladophor*a, Hymenoptera (wasps), cladocerans (water fleas), and detritus (Valdez and Carothers 1998). Adult humpback chub feed primarily on suspended material (drift) entrained in eddies, and juveniles favor local shoreline production in more sheltered habitats.

Razorback Sucker

The razorback sucker was listed as endangered in 1991 (56 FR 54957); critical habitat was designated in 1994 (59 FR 13374). In Grand Canyon, critical habitat extends from about RM 0 (the Paria River) to Hoover Dam. This species is also listed as WSCA. In the lower Colorado River basin, razorback suckers are now restricted to Lakes Mohave and Mead, and possibly to the Colorado River and tributaries in Grand Canyon. This species is extremely rare in Grand Canyon, with only 10 individuals recorded between 1944 and 1990, all adults (Valdez and Carothers 1998). Four of these records were from Bright Angel Creek: one fish caught in 1944, and three observed in 1987. No wild razorback suckers have been recorded in Grand Canyon since 1990, and the species is likely extirpated or nearly extirpated from the area. In 1997, 15 hatchery-raised razorback suckers were released by the Hualapai Tribe into the Colorado River at three locations in lower Grand Canyon (Zimmerman and Leibfried 1997). They did not persist in the area.

Razorback suckers prefer slower current and are found in backwaters, side channels, flooded bottomlands, pools, and lakes in the Colorado River drainage (AGFD 2002a). No evidence of reproduction in Grand Canyon has been recorded. Diet consists primarily of aquatic insect larvae, planktonic crustaceans, diatoms, *Cladophora*, and detritus filtered from bottom sediments.

Flannelmouth Sucker

The flannelmouth sucker is considered a species of concern by the USFWS. It is found in the mainstem throughout Glen and Grand Canyons and in most of the tributaries, including the Paria River, the Little Colorado River (LCR), Bright Angel Creek, Kanab Creek, Shinumo Creek, and Havasu Creek (Valdez and Carothers 1998). Tributaries and confluence areas have generally had higher densities of this species than the mainstem (Valdez and Ryel 1995). The canyon-wide population of flannelmouth suckers is relatively stable (Valdez and Carothers 1998). Predation by rainbow trout on flannelmouth suckers has been documented (Marsh and Douglas 1997). Adult suckers can reach 20 inches in length, and are unlikely to be preyed upon by trout; however, emergent fry, young-of-year, and juvenile suckers are susceptible to predation in spawning tributaries and the mainstem.

Flannelmouth suckers typically inhabit shallow, sheltered shorelines as young-of-year and juveniles, and the lower end of large, mid-channel cobble riffles in large rivers as adults (Valdez and Carothers 1998). Spawning generally occurs March-July and has been reported from the Paria River, the LCR, and Shinumo, Bright Angel, Kanab, Havasu, Spencer, and Surprise Canyon Creeks (Otis 1994, Valdez and Carothers 1998, AGFD 2001). Mainstem spawning also occurs in the tailwaters of Glen Canyon Dam (apparently unsuccessful because of cold water temperatures) and in western Grand Canyon (AGFD 1996, McKinney et al. 1999). Adult flannelmouth enter Bright Angel Creek only to spawn, remaining in the creek 3-6 weeks before returning to the mainstem (Otis 1994). Larval flannelmouth suckers drift quickly into the mainstem (Valdez and Carothers 1998). They may also fall prey to trout and other non-native predators while still in the tributary (Otis 1994). The flannelmouth sucker is predominantly a benthic (bottom) feeder, consuming a variety of plant and animal matter (midges, blackflies, *Gammarus*, diatoms, *Cladophora*, seeds, and organic detritus) it scoops up from bottom sediments.

Northern Leopard Frog

The northern leopard frog is listed as WSCA. A few adult frogs and tadpoles have been recorded from at least half a dozen sites along the Colorado River or in tributaries between Glen Canyon Dam and Lake Mead (Ward 2004). These sites include one in the Bright Angel Creek drainage. Recent surveys conducted in 2004 failed to discover Northern Leopard frogs in the Bright Angel Creek drainage (Ward 2004). Northern leopard frogs utilize springs, streams, and ponds as well as moist terrestrial habitat. Breeding takes place in March-May; eggs are deposited on submerged vegetation in shallow water, and tadpoles transform to frogs in June-August (Miller et al. 1982). Adult frogs consume small invertebrates; tadpoles and froglets feed mostly on algae and other aquatic plants (AGFD 2002b). Predators on the species in Grand Canyon likely include fish (including trout), snakes, skunks, and herons.

Bald Eagle

The bald eagle was listed as endangered in 1967 (32 FR 4001). In 1995, it was reclassified as threatened in the lower 48 states (60 FR 35999), and in 1999, it was proposed for delisting (64 FR 26453). This species is also listed as WSCA. Bald eagles do not nest in Grand Canyon, but they are frequent winter residents along the Colorado River and in tributaries. Their abundance has been correlated with the abundance of spawning trout in Nankoweap Creek (Brown et al. 1989, Brown and Stevens 1992). Biologists have conjectured that bald eagles may not have regularly wintered in Grand Canyon until increased rainbow trout populations attracted these birds in the mid-1980s (Brown et al. 1989). No information is available for the abundance and distribution of bald eagles along the Colorado River in Grand Canyon before construction of Glen Canyon Dam; however, this species was not present in early post-impoundment winter surveys. The first bald eagles were seen in 1985 at the mouth of Nankoweap Creek. At least one bald eagle has been observed recently in Bright Angel Canyon (GRCA 2003a, SWCA 2003). While both native and non-native fish probably provide food for bald eagles in Grand Canyon, the aggregations of spawning trout are likely the chief source. Bald eagles are unlikely to be present in Grand Canyon during the spring when aggregations of native fish spawn.

Osprey

The osprey is listed as WSCA by the AGFD. Ospreys winter sparingly along Colorado River in Grand Canyon but do not nest there (AGFD 2002c). They have been observed in Bright Angel Canyon during the trout spawn (SWCA 2003). Ospreys feed almost exclusively on fish but are also known to prey on frogs, snakes, and ducks.

Environmental Consequences

Methodology

The thresholds of change for the intensity of impact on special status species are defined as follows:

Negligible: An action that could result in a change to a population or individuals of a species or designated critical habitat, but the change would be so small that it would not be of any measurable or perceptible consequence. For federally listed species, negligible effect would equate with a "no effect" determination in USFWS terms.

Minor: An action that could result in a change to a population, individuals of a species, or designated critical habitat. The change would be measurable but small and localized and of little consequence. For federally listed species, an adverse minor effect would equate with a "may effect, likely to adversely effect the species of critical habitat". A beneficial minor effect would equate to "may effect, not likely to adversely affect" the species or critical habitat.

Moderate: An action that would result in some change to a population or individuals of a species or designated critical habitat. The change would be measurable and of consequence. For federally listed species, an adverse moderate effect would equate with a "may effect, likely to adversely effect the species or critical habitat". A beneficial moderate effect would equate to "may effect, not likely to adversely affect" the species or critical habitat.

Major: An action that would result in a noticeable change to a population or individuals of a species or resource or designated critical habitat. For federally listed species, an adverse major effect would equate with a "may effect, likely to adversely effect the species or critical habitat" or a jeopardy opinion. A beneficial major effect would equate to "may effect, not likely to adversely affect" the species or critical habitat.

Alternative A – No Action

Humpback Chub. Under the No Action Alternative, humpback chub would continue to be subject to current levels of predation by and competition with brown and rainbow trout spawned in Bright Angel Creek. Because humpback chub rarely occur in Bright Angel Creek, effects to this species would be felt in the mainstem and perhaps within the LCR. Both brown and rainbow trout would continue to exert predation and competitive pressures on humpback chub in the Bright Angel Creek Inflow Aggregation. Trout (particularly rainbow trout) and humpback chub compete for food resources, relying heavily on macroinvertebrates (aquatic insects in particular) in drift, *Gammarus*, and *Cladophora* (Valdez and Carothers 1998). Brown trout move greater distances than rainbow trout and may pose a threat to humpback chub in the LCR area.

The impact on humpback chub of allowing trout to continue to spawn in Bright Angel Creek would be minor in intensity, direct (predation) and indirect (competition), adverse, regional, and long term. The intensity of impact would likely be minor because the number of trout that spawn in the creek appears to be small compared to the total trout population in the area (see discussion under *Aquatic Resources* above).

Razorback Sucker. Because of the extreme rarity of razorback suckers in Grand Canyon, and the unlikelihood that young razorback suckers small enough to be susceptible to predation are present anywhere near Bright Angel Creek, it is unlikely that No Action would have any effect on this species. If any individual razorback suckers do persist in the area, they would be large adults and invulnerable to predation. At most, adverse impacts would be negligible.

Flannelmouth Sucker. Like humpback chub, flannelmouth sucker is primarily a resident of the mainstem, but unlike humpback chub it also spawns in Bright Angel Creek. Under this alternative, resident trout in the creek would continue to pose a threat to young suckers as they hatch and drift to the mainstem. The degree to which predation is likely to occur is unknown. It is known, however, that trout prey upon young flannelmouth suckers elsewhere in the system (Marsh and Douglas 1997). Potential impacts of this alternative on this species would be similar to those on humpback chub.

Northern Leopard Frog. Under the No Action Alternative, if northern leopard frogs occur in the Bright Angel Creek drainage, trout may compete with them for food (algae and small invertebrates). Trout, particularly brown trout, may also prey on frog eggs, larvae, and tadpoles. Given the uncertainty of the frog's presence, however, and the low population number if the species is present, as well as the lack of information about possible predation by trout, this alternative is likely to have no effect or, at most, a negligible, direct, adverse, local, and long-term effect on the species.

Bald Eagle. Under this alternative, small numbers of bald eagles (apparently only one in recent years) would continue to visit Bright Angel Creek in the winter to feed on spawning trout. The number of trout available as food for bald eagles in Bright Angel Creek and the mainstem would not diminish as a result of this alternative. The impacts of No Action would be indirect, beneficial, regional, and long term. Given the relatively small number of trout that spawn in Bright Angel Creek compared to the total biomass of trout in the area, the intensity of impact on this species of allowing the spawn to continue would be minor at best.

Osprey – The impacts of this alternative on ospreys would be similar to those on bald eagles.

Cumulative Impacts

The combined past, present, and future non-native trout reduction programs in GRCA may result in a moderate, indirect, beneficial, and regional effect on humpback chub and flannelmouth sucker. Most of that impact would be attributable to dam operations and mechanical trout removal in the mainstem (see the *Cumulative Impact* discussion under "Aquatic Resources" above). Potential adverse cumulative effects of handling humpback chub and flannelmouth sucker would be negligible because uniform protocols would be applied in all actions to minimize stress and injury to individual fish. These impacts would be local and short term. Potential cumulative effects, both beneficial and adverse, on razorback sucker and northern leopard frog would be negligible at most, local, and short term. The cumulative effect of trout reduction efforts on the bald eagle and osprey are likely to be minor in the vicinity of the LCR and Bright Angel Creek, with the GCMRC program accounting for most of the impact. The EA for that program predicted the long-term impacts on bald eagles to be "measurable," no more. The Bright Angel Creek reduction effort, being of much smaller scale, would add little to the cumulative adverse effects on these species.

Water diversions for consumptive use, tamarisk removal, and current construction work in Bright Angel Canyon would not contribute to cumulative impacts on any special status species addressed in this EA.

Alternative B – Mechanical Removal (Preferred Alternative)

Humpback Chub. Under Alternative B, fewer trout would be present in the Colorado River system to prey on and compete with humpback chub. This is expected to increase the survivorship of young humpback chub in the mainstem (and possibly the LCR), resulting in a potential minor, direct (predation) and indirect (competition), beneficial, regional impact on the species. The duration of the impact would depend on the duration of the action. If the trout persist in the mainstem, they will eventually resume spawning in Bright Angel Creek if the weir operation is terminated.

Individual humpback chub may enter the weir and be subjected to handling. In that event, established protocols would be followed to minimize stress and injury to the fish (see fish handling procedures in the "Mitigation Measures" section of Chapter 2). Humpback chub are not expected to be far enough upstream in Bright Angel Creek to be affected by electrofishing operations. The potential impact from capturing a humpback chub in the weir would be negligible, direct, adverse, local, and short term.

Razorback Sucker. Because of the extreme rarity of razorback suckers in Grand Canyon, it is unlikely that a reduction in trout populations would affect the species. There is a remote possibility that an individual adult razorback sucker may enter the weir. In that event, established protocols would be followed to minimize stress and injury to the fish. Any potential impact would be negligible, direct, adverse, local, and short term.

Flannelmouth Sucker. The reduction of trout in both Bright Angel Creek and the mainstem would benefit flannelmouth suckers by decreasing predation pressures. This may be particularly beneficial for emergent fry and drifting larval suckers in the creek and in the Bright Angel inflow area. The resulting potential impact would be minor, indirect, beneficial, and regional. As with humpback chub, the duration of impact would depend on the duration of the action.

Flannelmouth suckers would be captured, processed, and released at the weir during the spring spawning run. They may also be captured by electrofishing during the depletion surveys. To minimize potential stress and injury to the fish from handling and electrofishing, established protocols would be followed (see fish handling and electrofishing procedures in the "Mitigation Measures" section of Chapter 2). The potential impact from capturing flannelmouth suckers would be negligible, direct, adverse, local, and short term.

Northern Leopard Frog. If northern leopard frogs are present in Bright Angel Creek, the reduction of trout in the stream may benefit them by increasing the availability of food and reducing predation pressure. These potential beneficial effects would be negligible and indirect. The duration of impact would depend on the duration of the action. If northern leopard frogs are present in water being electrofished, they may be immobilized. If so, they would be removed immediately from the influence of the electrical field and transported to similar habitat outside the depletion reach. Hypothetically, injury may occur to an adult frog's vertebral column because such injury has been observed in fish. However, injuries in fish have been correlated with large fish size and the high amperage of boat electrofishers (Sharber et al.). Injuries are not expected to be an issue for small animals like leopard frogs, especially at the low amperage levels generated by a backpack electrofisher. Electrofishing is an accepted method for amphibian surveys, and no spinal injuries have been documented in these animals (USFWS no date). If northern leopard frogs are present in Bright Angel Creek, the potential impact of electrofishing and handling would be negligible, direct, adverse, local, and short term.

Bald Eagle. Under this alternative, trout would become increasing unavailable in Bright Angel Creek as a food source for the small number of bald eagles (apparently only one in recent winters) that have been observed near the mouth of the creek. Some trout would continue to be available below the weir, probably in decreasing numbers each year. The bald eagle(s) accustomed to visiting Bright Angel Creek would have ample time to find more productive fishing sites elsewhere within Grand Canyon. The potential impact on bald eagles at Bright Angel Creek would be minor, indirect, adverse, and local. The duration of impact would depend on the duration of the action.

Alternative B would also reduce trout abundance to some degree in the river reach several miles upstream and downstream of the Bright Angel confluence, thus reducing available food for bald eagles in that area. The magnitude of that reduction is unknown with any precision at this time, but it is expected to be a small percentage of the total trout population (see the discussion of impacts on non-native fish in the "Aquatic Resources" section above). Because this alternative is expected to reduce the overall biomass of trout in the Colorado River system by only a small percentage, the reduction in food availability for bald eagles in the mainstem is expected to be negligible.

Osprey. The impacts of this alternative on ospreys would be similar to those on bald eagles.

Cumulative Impacts

The combined past, present, and future non-native trout reduction programs in GRCA may result in a moderate, indirect, beneficial, and regional effect on humpback chub and flannelmouth sucker. Most of that impact would be attributable to dam operations and mechanical trout removal in the mainstem (see the *Cumulative Impact* discussion under "Aquatic Resources" above). Potential adverse cumulative effects of handling humpback chub and flannelmouth sucker would be negligible because uniform protocols would be applied in all actions to minimize stress and injury to individual fish. These impacts would be local and short term. Potential cumulative effects, both beneficial and adverse, on razorback sucker and northern leopard frog would be negligible at most, local, and short term. The cumulative effect of trout reduction efforts on the bald eagle and osprey are likely to be minor in the vicinity of the LCR and Bright Angel Creek, with the GCMRC program accounting for most of the impact. The EA for that program predicted the long-term impacts on bald eagles to be "measurable," no more. The Bright Angel Creek reduction effort, being of much smaller scale, would add little to the cumulative adverse effects on these species.

Water diversions for consumptive use, tamarisk removal, and current construction work in Bright Angel Canyon would not contribute to cumulative impacts on any special status species addressed in this EA.

Conclusions

Alternative A - No Action. This alternative is expected to adversely affect humpback chub and flannelmouth sucker by continuing and probably increasing predation and competition pressures from the trout that spawn in Bright Angel Creek. Effects would be minor and more likely felt in the mainstem Colorado River than in the creek. If northern leopard frogs are present in Bright Angel Creek, No Action may adversely affect them for the same reason, although impacts would be negligible at most and confined to the creek. Bald eagle and osprey would benefit from the continuing and probably increasing availability of trout as prey.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA;

(2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

Alternative B – Mechanical Removal (Preferred Alternative). This alternative is expected to benefit humpback chub and flannelmouth sucker by reducing predation and competition pressures from the trout that spawn in Bright Angel Creek. These effects would be minor and more likely felt in the Colorado River than in the creek, with the duration of the impact depending on the duration of the action. The potential adverse impact of capturing individual humpback chub, flannelmouth sucker, or razorback sucker in the weir would be negligible and short term. Utilization of appropriate fish handling protocols would mitigate the impact. Northern leopard frog may benefit from an increase in food availability and reduction in predation pressure, but effects are likely to be negligible. The potential adverse impact of electrofishing would likely be negligible as well. Bald eagles and ospreys may be adversely affected to a minor degree as a result of fewer trout being available for food, particularly in the Bright Angel Creek inflow area during the spawn. The duration of impact would depend on the duration of the action. The reduction in food availability for bald eagles and ospreys in the mainstem is expected to be negligible.

Impacts under the Preferred Alternative are primarily beneficial. Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

CULTURAL RESOURCES

Affected Environment

Historic Properties

The project occurs within the Cross Canyon Corridor Historic District. The corridor trails were used prehistorically and pass very near many archeological sites of varying size and importance. The trails have been surveyed for archeological resources but these surveys are of poor quality. Archeological sites near trails often receive some of the greatest impacts from erosion and illicit collection. Phantom Ranch contains one well-studied pueblo with a number of features, and human burials have been found nearby.

The Cross Canyon Corridor Historic District includes 44 buildings and structures and the Bright Angel, South Kaibab, North Kaibab and connecting river trails. The Phantom Ranch complex along Bright Angel Creek consists of approximately 20 buildings used by both the park concessionaire (Xanterra Parks and Resorts) and NPS. The five original stone buildings designed by Mary Jane Colter and constructed in 1922 comprise the heart of the complex, but several other structures (cabins, dining hall, shower building, etc.) contribute to the integrity of the area. Bright Angel Campground is the site of the 1920's Civilian Conservation Corps (CCC). The Transcanyon Telephone Line District is about 18 miles long and roughly parallels the Bright Angel and North Kaibab Trails from the South Rim to Roaring Springs, with a spur line running 2 miles up the South Kaibab Trail. The line consists of almost 600 metal poles strung with copper-weld wire. The poles were installed in 1935, with some modifications made in 1938-1939 to provide the Park Service with its own telephone system.

These archeological and historic resources are adjacent to but not within the area of potential effect, and will not be affected by this project. Therefore, they will not be evaluated further in this chapter.

The Phantom Ranch area has not yet been evaluated as a potential cultural landscape, but the project would not affect it if it were found to be eligible for that designation. **Therefore, cultural landscapes will also not be evaluated further in this chapter.**

Ethnographic Resources
Ethnographic resources are defined by the NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional, legendary, subsistence, or other significance in the cultural system of a group traditionally associated with it" (Cultural Resource Management Guidelines [DO-28:191]). The lands of Grand Canyon National Park are traditionally affiliated with nine American Indian groups: Havasupai, Hopi, Hualapai, Kaibab Band of Paiute Indians, Navajo, Paiute Indian Tribe of Utah, White Mountain Apache, San Juan Southern Paiute, and Pueblo of Zuni. The Grand Canyon has long been of importance to native cultures and figures prominently in the origin/religious beliefs and ceremonial practices of many groups. For example, traditional Hopi and Zuni beliefs hold the Grand Canyon as the sacred place from which their ancestors emerged to the present world (NPS 2001).

Tribal studies of the Colorado River corridor (Neal and Gilpin 2000) identified ethnographic resources that occur within GRCA, primarily on the river corridor but in other areas as well. These included archeological sites (including rock art sites, trails, and graves), sacred sites, places mentioned in traditional history, subsistence areas, boundary line, natural landmarks, minerals, plants, animals and water (including springs). Although ethnographic resources significant to Native Americans may be present in the project area, no ethnographic resources are known to exist within the vicinity of the project site.

Copies of this EA/AEF will be forwarded to each affiliated tribe for review and comment. If the tribes subsequently identify the presence of ethnographic resources within the project area, appropriate mitigation measures would be undertaken in consultation with the tribes.

Environmental Consequences

Methodology

The baseline information used to assess impacts to cultural resources is as described in the methodology section at the beginning of this chapter and includes park staff knowledge of the resources and site; review of existing literature and park studies; information provided by specialists within the National Park Service and other agencies; and professional judgment. Detailed information on natural and cultural resources in Grand Canyon National Park that is summarized in the 1995 GMP and associated Environmental Impact Statement (EIS) was specifically referenced for information on affected resources in the project area.

Because no archeological or historical resources or cultural landscapes will be affected by the project, they will not be discussed further.

Ethnographic Resources. The definitions for levels of impact to ethnographic resources are as follows:

Negligible: Impact(s) would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. There would be no change to a group's body of beliefs and practices. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *no adverse effect.*

Minor: Adverse impact - impact(s) would be slight but noticeable and would neither appreciably alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *no adverse effect.*
Beneficial impact - would allow access to and/or accommodate a group's traditional practices or beliefs. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *no adverse effect.*

Moderate: Adverse impact - impact(s) would be apparent and would alter resource conditions. Something would interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's body of beliefs and practices, even though the group's practices and beliefs would survive. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *adverse effect.*
Beneficial impact - would facilitate traditional access and/or accommodate a group's practices or beliefs. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *no adverse effect.*

Major: Adverse impact - impact(s) would alter resource conditions. Something would block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's body of beliefs and practices, to the extent that the survival of a group's beliefs and/or practices would be jeopardized. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *adverse effect*
Beneficial impact - would encourage traditional practices and/or accommodate a group's beliefs or practices. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be *no adverse effect.*

Alternative A – No Action

No known ethnographic resources are being affected in the project area (i.e., negligible impacts). If upon review of this EA/AEF or further consultation, any of the affiliated tribes subsequently identify the presence of ethnographic resources within the project area, appropriate mitigation measures would be undertaken in consultation with the tribes. The location of any ethnographic sites would not be made public.

Cumulative Impacts

No cumulative impacts of consequence are anticipated to ethnographic resources from the several actions affecting Bright Angel Canyon and trout populations in GRCA (i.e., negligible cumulative impacts).

Alternative B – Mechanical Removal (Preferred Alternative)

No known ethnographic resources are expected to be affected by the preferred alternative in the project area (i.e., negligible impacts). If upon review of this EA/AEF or further consultation, any of the affiliated tribes subsequently identify the presence of ethnographic resources within the project area, appropriate mitigation measures would be undertaken in consultation with the tribes. The location of any ethnographic sites would not be made public.

Cumulative Impacts

No cumulative impacts of consequence are anticipated to ethnographic resources from the several actions affecting Bright Angel Canyon and trout populations in GRCA (i.e., negligible cumulative impacts).

Conclusions

Alternative A - No Action. This alternative would result in no changes to ethnographic resources in GRCA (i.e., negligible impacts). Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

Alternative B – Mechanical Removal (Preferred Alternative). This alternative would result in no changes to ethnographic resources in GRCA, and no known ethnographic resources would be affected (i.e., negligible impacts). Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

§106 Summary: After applying the Advisory Council Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, Assessment of Adverse Effects), the National Park Service concludes that implementation of the preferred alternative would have *no affect* on historic properties or on ethnographic resources.

VISITOR EXPERIENCE

Affected Environment

The loss of recreational fishing in Bright Angel Creek was a visitor experience-related issue raised during scoping for this EA. Anglers have been participating in the sport fishery in the creek since trout were first introduced in the 1920s. Public interest was sufficiently high over four decades for the NPS to repeatedly stock the creek after recurrent floods wiped out the fishery. Stocking ceased in 1964 after Glen Canyon Dam altered conditions in the Colorado, allowing trout to survive and reproduce in the mainstem (Valdez

and Carothers 1998). Rainbow trout once dominated the sport fishery, with some stocked brook, brown, and cutthroat trout. In recent years, brown trout have dominated the catch, although rainbow trout are still common. The proportion of species in the assemblage depends in part on the time of year because brown trout spawn somewhat earlier in the winter than do rainbow trout. Fishing in Bright Angel Creek is unlimited (no bag or size limits).

This recreational opportunity has long been popular with a small segment of park visitors, but that segment appears to be declining. Quantitative data from a creel census conducted in the winter of 1977-1978 indicated that an average of 6.3 anglers was counted each day for 20 days (Table 4). In the most recent creel census, conducted in the winter of 1989-1990, an average of 4.8 anglers were counted each day for 73 days. Popularity of the fishery may have peaked in the 1980s. NPS personnel on-site during that period report seeing 20 or more anglers along the creek on the busiest days. In recent years only one to three anglers are seen on a typical day, with use highest in spring and fall (Sjors 2004). The total annual number of individual anglers has ranged from a low of about 75 to a high of about 200 (Kassovic 2004). Fishing pressure at Bright Angel Creek has always been relatively low because of the difficult access (by foot or mule down long and steep trails), but the reasons for the decline in use over the last 10-15 years are unclear. They may be related to the shift in the fish assemblage from predominantly rainbow trout to predominantly brown trout, to a change in the condition or abundance of trout, or to other factors.

Table 4. Creel census data from Bright Angel Creek, winter 1977-1978 and 1989-1990.

	1977-1978*	**1989-1990****
Number of creel count days	20	73
Number of interviews	126	351
Total hours spent fishing	417.15	1,205.3
Percentage of anglers catching fish	56%	93%
Total number of fish caught and kept	121	409
Total number of fish released	84	3,166
Catch per person-hour	0.49	2.97
Hour per angler	3.31	3.43
Fish per day	10.25	48.97
Number of fishermen per day	6.3	4.8

* Source: Carothers and Minckley (1981); last four categories extrapolated from first six categories.
** Source: Kline at al. (1990); last four categories extrapolated from first six categories.

Anglers comprise a small percentage of the thousands who visit the Bright Angel Creek area each year and a miniscule percentage of the 4-5 million visitors to GRCA. Most people visit GRCA to experience one of the premier geologic and scenic wonders of the world. The vast majority remain on the rims, enjoying the Canyon's vistas from numerous viewpoints. Those who venture to the bottom are generally interested in hiking, camping, exploring, river running, or reveling in the rugged scenery. They are drawn by the adventure, physical challenge, wildlife, and wild character of the place. Sport fishing plays a minor role in the full spectrum of recreational activities offered by GRCA. Still, for the few dedicated anglers who regularly fish Bright Angel Creek, angling in the spectacular setting at the bottom of Grand Canyon is a unique and prized experience.

Environmental Consequences

Methodology

The thresholds of change for the intensity of impact on visitor experience in GRCA are defined as follows:

> **Negligible:** There would be no effects on visitor use and/or experience, or if there are effects they would be at the lowest levels of detection. Effects would be short term. Visitors would not likely be aware of the effects.
>
> **Minor:** Changes in visitor use and/or experience would be detectable, although short term, slight, and limited in scope. Some visitors would be aware of the effects. Minor inconveniences would occur that would not significantly change most visitor use patterns or degrade the experience of most visitors.
>
> **Moderate:** Changes in visitor use and/or experience would be readily apparent and likely long term. Many visitors would be aware of the changes and would likely express comments about the changes.
>
> **Major:** Changes in visitor use and/or experience would be apparent and have significant long-term consequences. The use patterns and behaviors of most visitors would be altered. Changes would illicit strong opinion from visitors.

Alternative A – No Action

This alternative would result in no changes to visitor experience in GRCA. Angling in Bright Angel Creek would still be available as a recreational opportunity for visitors to the Phantom Ranch area.

Cumulative Impacts

No cumulative impacts of consequence are anticipated to visitor experience from the several actions affecting Bright Angel Canyon and trout populations in GRCA. Most construction projects affecting Bright Angel Canyon would have short-term adverse impacts and would provide long-term benefits to the visitor experience in the area.

Alternative B – Mechanical Removal (Preferred Alternative)

Under this alternative, the quality of angling in Bright Angel Creek would be reduced. During the trout spawn in winter, the abundance of trout immediately upstream of the weir would diminish compared to No Action, although in the first years of the project recreational fishing would still be productive downstream of the weir and along the banks of the Colorado River. Over subsequent years, as returning trout are eliminated, the quality of angling downstream of the weir would diminish as well. Eventually, few trout would be available anywhere in Bright Angel Creek, but some trout would always be available in the river. A small portion of visitors to the area would still fish as an incidental part of their experience, but fewer individuals would travel to the area solely or principally to fish. The loss of the

sport fishery would be felt by up to an estimated 200 visitors per year, but for the overwhelming majority of the Park's 4-5 million visitors, the change would go unnoticed. Consequently, the impacts to visitor experience at GRCA would be minor, indirect, adverse, and local. The duration of the impacts would depend on the duration of the action but is likely to be long term.

Few visitors to Bright Angel Creek would see the weir. It would be placed in an unobtrusive location near the mouth of the creek, out of sight of the main trail. People crossing a footbridge to a public restroom and ranger station may notice the structure from the bridge. If anyone approaches the weir and expresses interest, the biologist on duty would explain the purpose of the project. Electrofishing depletion reaches upstream in the creek would be selected in part with visitor sensibilities in mind. Again, project personnel would take time to explain the purpose of the project to any visitor who notices the operation and expresses interest. Impacts on the aesthetic qualities of Bright Angel Creek and intrusions to visitor experience would be negligible, direct, adverse, and short term.

Cumulative Impacts

No cumulative impacts of consequence are anticipated to visitor experience from the several actions affecting Bright Angel Canyon and trout populations in GRCA. Most construction projects affecting Bright Angel Canyon would have short-term adverse impacts and would provide long-term benefits to the visitor experience in the area.

Conclusions

Alternative A - No Action. This alternative would result in no changes to visitor experience in GRCA. Angling in Bright Angel Creek would still be available as a recreational opportunity in the Park. Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of GRCA; (2) key to the natural or cultural integrity of the Park or to opportunities for enjoyment of the Park; or (3) identified as a goal in the Park's general management plan or other relevant NPS planning documents, there would be no impairment of the Park's resources or values.

Alternative B – Mechanical Removal (Preferred Alternative). Only a very small proportion of the visitors to GRCA would be aware of the effects of the Preferred Alternative on sport fishing in Bright Angel Creek. Most visitor use patterns in the Park would not change. As a result, while impacts on visitor experience would be adverse, they would be minor in intensity and local.

CHAPTER 4 – CONSULTATION AND COORDINATION

EXTERNAL SCOPING/PUBLIC INVOLVEMENT

Public scoping began on December 10, 2003, with letters sent to 283 recipients, including Native American tribes, stakeholder groups, agencies, libraries, and private individuals who were likely to be interested in, or concerned about, the proposed action (see Appendix B for a copy of the scoping letter). The letter was also posted on the GRCA Web site. Public scoping ended on January 12, 2004. Comments in the form of e-mails, letters, and phone conversations with park staff were received from 50 respondents, including 44 individuals, 5 organizations, and 1 state agency (Arizona Game and Fish Department).

In addition to public scoping, results of the 2003 Bright Angel Creek feasibility study and the proposed action were presented to stakeholder groups and the scientific community on two occasions. On October 1, 2003, a presentation was made to a meeting of the Glen Canyon Adaptive Management Program Technical Work Group. Representatives of the following groups were in attendance:

Arizona Department of Water Resources	Northern Arizona University
Arizona Game and Fish Department	Pueblo of Zuni
Colorado River Board of California	Southern Paiute Consortium
Colorado River Commission of Nevada	U.S. Bureau of Indian Affairs
Colorado Water Conservation Board	U.S. Bureau of Reclamation
EcoPlan Associates	U.S. Fish and Wildlife Service
Federation of Fly Fishers	U.S. Geological Survey, Grand Canyon Monitoring and Research Center
Grand Canyon River Guides	U.S. National Park Service, Glen Canyon National Recreation Area
Grand Canyon Trust	U.S. National Park Service, Grand Canyon National Park
Grand Canyon Wildlands Council	U.S. Western Area Power Administration
Hualapai Tribe	Upper Colorado River Commission
Irrigation and Electrical Districts Association	Utah Associated Municipal Power Service
New Mexico Interstate Stream Commission	Wyoming State Engineer's Office

On October 29, 2003, a similar presentation was made at a science symposium sponsored by GCMRC (*The Colorado River: An Ecosystem Science Symposium*, Tucson, Arizona, October 28-30, 2003). Feedback from both presentations, as well as public and agency comments received during the scoping period, were taken into account when considering alternatives and issues to be analyzed for this document.

AGENCY CONSULTATION

US Fish and Wildlife Service

The Park developed a Biological Assessment (December 16, 2003) that was submitted to the Phoenix office of the US Fish and Wildlife Service on December 22, 2003. The park requested and obtained concurrence that the proposed action (Alternative B) was "not likely to adversely affect" humpback chub or California condor. On February 9, 2004, the Park requested formal consultation for the bald eagle. On March 2, 2004, the US Fish and Wildlife Service issued a Biological Opinion concluding that the project, as proposed, is "not likely to jeopardize the continued existence of the bald eagle."

State Historic Preservation Office

Initiation of consultation with the State Historic Preservation Office occurred on 18 November 2003. Review and comment of this EA/AEF will constitute completion of consultation with the SHPO's office.

American Indian Tribes

NPS is initiating consultation with all affiliated tribes (Havasupai, Hopi, Hualapai, Kaibab Band of Paiute Indians, Navajo, Paiute Indian Tribe of Utah, White Mountain Apache, Yavapai Apache, San Juan Southern Paiute, Moapa Band of Paiute, Las Vegas and Pueblo of Zuni) as part of the review of the EA/AEF. A letter with an attached copy of the EA/AEF was distributed to all affiliated tribes for their review and comment.

Other Agencies and Government Representatives

Letters were sent to Arizona Game and Fish Department, members of the Glen Canyon Dam Adaptive Management Program and affiliated groups, other local and regional agencies, and government representatives announcing the availability of the EA/AEF and inviting comments.

INTERNAL SCOPING

Internal scoping was conducted by an interdisciplinary team of professional from Grand Canyon National Park. Interdisciplinary team met at the parkwide interdisciplinary team and the project review board.

ENVIRONMENTAL ASSESSMENT/ASSESSMENT OF EFFECT REVIEW AND LIST OF RECIPIENTS

The Environmental Assessment/Assessment of Effect will be released for public review in August 2006. To inform the public of the availability EA/AEF, the NPS is publishing and distributing a press release, a letter to various agencies, tribes, and members of the public that responded to the public scoping in 2003-2004, and a letter to the park's mailing list for such projects. Copies of the EA/AEF will be provided to interested individuals, upon request. Copies of the document will also be available for review at www.parkplanning.nps.gov/grca.

The EA/AEF is open for a 30 day public comment period ending October 2, 2006. During this time, the pubic is encouraged to submit their written comments to the National Park Service address provided at the beginning of this document. Following the close of the comment period, all public comments will be reviewed and analyzed, prior to the release of a decision document.

PREPARERS AND CONTRIBUTORS:

This document was developed in stages following the public scoping period. A draft EA/AEF was prepared for internal NPS review in 2004-2005. In 2006, the draft EA/AEF was revised based upon the internal review comments and this document was prepared for public review.

CONTRIBUTORS TO EA/AEF

Grand Canyon National Park

Jeffrey Cross, former Science Center Director
R.V. Ward, Park Biologist
Sara White, former Compliance Officer
Jill Beshears, Environmental Protection Specialist
Mary Killeen, Chief, Office of Planning and Compliance
Jan Balsom, Acting Science Center Director

PREPARERS OF EA/AEF

SWCA Environmental Consultants

William C. Leibfried, Senior Scientist
Dorothy A. House, NEPA Specialist
Kevin Serrato, Biologist

PREPARERS OF EA/AEF

Grand Canyon National Park

Rick Ernenwein, Planner, Office of Planning and Compliance

SELECTED REFERENCES

FEDERAL STATUTES

National Park Service Organic Act of 1916

Clean Air Act of 1963, as amended (CAA)

Wilderness Act of 1964

National Historic Preservation Act of 1966, as amended (NHPA)

National Environmental Policy Act 1969, as amended (NEPA)

Clean Water Act of 1972

Endangered Species Act of 1973, as amended (ESA)

Archeological Resources Protection Act of 1979 (ARP)

Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)

EXECUTIVE ORDERS

Executive Order 11990 (Wetlands)

Executive Order 11988 (Floodplain Management)

Executive Order 12898 (Environmental Justice)

Executive Order 13007 (Sacred Sites)

Executive Order 13112 (Invasive Species)

DEPARTMENT OF THE INTERIOR DIRECTIVES

Secretarial Order 3175 (Indian Trust Assets)

Environmental Compliance Memorandum (ECM) 95-2 (Indian Trust Assets)

NATIONAL PARK SERVICE DIRECTIVES, POLICIES, AND PLANS

Director's Order 12 Conservation Planning, Environmental Impact Analysis and Decision Making

Director's Order 47 Sound Preservation and Noise Management

Director's Order 55 Interpreting the National Park Service Organic Act.

National Park Service Management Policies Handbook (1978)

National Park Service management policies 2001

National Park Service Strategic Plan, FY 2001 – 2005

GRAND CANYON NATIONAL PARK DOCUMENTS

Fish Management Plan for Grand Canyon National Park (1981)

Final Wilderness Recommendation (1993)

Grand Canyon National Park General Management Plan (1995)

Grand Canyon National Park Resource Management Plan (1997)

FEDERAL REGISTER PUBLICATIONS

U.S. Fish and Wildlife Service (USFWS). 1967. Native Fish and Wildlife, Endangered Species. Federal Register 32(205):4001. March 11, 1967.

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened Wildlife and Plants: Determination of Critical Habitat for Four Colorado River Endangered Fishes; Final Rule. Federal Register 59 (54):13374–13400. March 21, 1994.

U.S. Fish and Wildlife Service (USFWS). 1991. Endangered and Threatened Wildlife and Plants; The Razorback sucker, Xyrauchen texanus, determined to be an endangered species. Federal Register: Volume 56 (205):54957–54967. October 23, 1991.

U.S. Fish and Wildlife Service (USFWS). 1995. Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify the Bald Eagle From Endangered to Threatened in All of the Lower 48 States. Federal Register (133):35999–36010. July 12, 1995.

U.S. Fish and Wildlife Service (USFWS). 1999. Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register 64(128):36453–36464. July 6, 1999.

REFERENCES CITED

Arizona Game and Fish Department (AGFD). 1996. Ecology of Grand Canyon backwaters. Prepared for the Bureau of Reclamation, Upper Colorado Region, Glen Canyon Environmental Studies, Flagstaff, Arizona. Cooperative agreement No. 9-FC-40-07940.

Arizona Game and Fish Department (AGFD). 2001. *Catostomus latipinnis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix. On-line at: http://www.azgfd.com/wildlife_conservation/edits/hdms_abstracts_fish.html.

Arizona Game and Fish Department (AGFD). 2002a. *Xyrauchen texanus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix. On-line at: http://www.azgfd.com/wildlife_conservation/edits/hdms_abstracts_fish.html.

Arizona Game and Fish Department (AGFD). 2002b. *Rana pipiens*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix. On-line at: http://www.azgfd.com/wildlife_conservation/edits/hdms_abstracts_amphibians.html.

Arizona Game and Fish Department (AGFD). 2002c. *Pandion haliaetus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix. On-line at: http://www.azgfd.com/w_c/edits/hdms_abstracts_birds.html.

Blinn, D.W., C. Runck, D.A. Clark, and J.N. Rinne. 1993. Effects of rainbow trout predation on Little Colorado spinedace. Transactions of the American Fisheries Society 122:139–143.

Brown, B.T., and L.E. Stevens. 1992. Winter abundance, age structure, and distribution of bald eagles along the Colorado River, Arizona. The Southwestern Naturalist 37(4):404–435.

Brown, B.T., R. Mesta, L.E. Stevens, and J. Weisheit. 1989. Changes in winter distribution of bald eagles along the Colorado River in Grand Canyon, Arizona. Journal of Raptor Research 23(3):110–113.

Carothers, S.W., and C.O. Minckley. 1981. A survey of the aquatic flora & fauna of the Grand Canyon. [Submitted to] U.S. Department of the Interior, Water and Power Resources Service, Boulder City, Nevada. Department of Biology, Museum of Northern Arizona, Flagstaff.

Coggins, L., and M. Yard. 2003. Mechanical removal of non-native fishes in the Colorado River in Grand Canyon: Update of winter 2003 operations and findings. A report to the Glen Canyon Dam Adaptive Management Program. Southwest Biological Science Center, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona.

Coggins, L., M. Yard, and C. Paukert. 2002. Piscivory by non-native salmonids in the Colorado River and an evaluation of the efficacy of mechanical removal of non-native salmonids. Grand Canyon Monitoring and Research Center, U.S. Geologic Survey, Flagstaff, Arizona.

Coggins, L., C. Walters, C. Paukert, and S. Gloss. 2003. An overview of status and trend information for the Grand Canyon population of the humpback chub (*Gila cypha*). Prepared by the Grand Canyon Monitoring and Research Center, USGS, Flagstaff, Arizona, for the Glen Canyon Dam Adaptive Management Work Group Ad Hoc Committee on Humpback Chub.

Council on Environmental Quality (CEQ). 1981. Memorandum to agencies: Forty most-asked questions concerning CEQ's National Environmental Policy Act regulations. Federal Register 46:18026.

Department of the Interior (DOI). 2002. Proposed Releases from Glen Canyon Dam and Removal of Non-Native Fish. Bureau of Reclamation, National Park Service, U.S. Geological Survey.

Grand Canyon Monitoring and Research Center (GCMRC). 2003a. Proposed two-year science plan for experimental flow treatments and mechanical removal activities in WY's 2002–2004. Glen Canyon Dam Adaptive Management Program. Flagstaff, Arizona.

Grand Canyon Monitoring and Research Center (GCMRC). 2003b. An overview of status and trend information for the Grand Canyon population of the humpback chub, *Gila Cypha*. Glen Canyon Dam Adaptive Management Work Group. Ad Hoc Committee on Humpback chub. Flagstaff, Arizona.

Grand Canyon Monitoring and Research Center (GCMRC). 2006. Grand Canyon Humpback Chub Population Stabilizing. U.S. Geological Survey Fact Sheet 2006-3109, July 2006. Flagstaff, Arizona.

Grand Canyon National Park (GRCA). 1981. Fish Management Plan for Grand Canyon National Park.

Grand Canyon National Park (GRCA). 1994. [Streamflow and water quality data collected 1994–1994 under the supervision of John Rihs, Grand Canyon National Park geologist. On-file in the Grand Canyon National Park Science Center, Grand Canyon, Arizona.]

Grand Canyon National Park (GRCA). 2002a. Tamarisk management and tributary restoration: Environmental assessment. Grand Canyon National Park, Grand Canyon, Arizona.

Grand Canyon National Park (GRCA). 2002b. Finding of No Significant Impact: Tamarisk management and tributary restoration. Grand Canyon National Park, Grand Canyon, Arizona.

Grand Canyon National Park (GRCA). 2003a. Upgrade corridor area fire protection: Environmental assessment. Grand Canyon National Park, Grand Canyon, Arizona.

Grand Canyon National Park (GRCA). 2003b. Finding of No Significant Impact (FONSI): Upgrade corridor area fire protection system, Grand Canyon National Park. Grand Canyon National Park, Grand Canyon, Arizona.

Grand Canyon National Park (GRCA). 2005. Finding of No Significant Impact (FONSI): Construct, Rehabilitate and Repair Restrooms Parkwide. Grand Canyon National Park, Grand Canyon, Arizona.

Grisak, G., and B. Marotz. 2003. South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program. Project No. 1991-01903. BPA Report DOE/BP-00005043-1. Bonneville Power Administration, Portland, Oregon.

Haden, A. 1992. Nonnative fishes of the Grand Canyon, a review with regards to their effects on native fishes. Glen Canyon Environmental Studies, Flagstaff, Arizona.

Hawkins, J.A., and T.P. Nesler. 1991. Nonnative fishes of the Upper Colorado River Basin: An issue paper. Final report to U.S. Fish and Wildlife Service.

Holden, P.B., and C.B. Stalnaker. 1975. Distribution and abundance of mainstream fishes of the middle and upper Colorado River Basin, 1967–1973. Transactions of the American Fisheries Society 104(2):217–231.

Humpback Chub Ad Hoc Committee. 2003. Status and management strategy for humpback chub in Grand Canyon. Report of the Humpback Chub Ad Hoc Committee to the Adaptive Management Work Group of the Glen Canyon Dam Adaptive Management Program. Flagstaff, Arizona.

Kassovic, I. (Grand Canyon National Park). 2004. Personal communication to K. Serrato, SWCA Environmental Consultants, Flagstaff, Arizona. February 19.

Kline, D., R. Lechleitner, and Sjors. 1990. Bright Angel creel survey: November 18, 1989, to February 8, 1990. Grand Canyon National Park, Grand Canyon, Arizona.

Maddux, H.R., D.M. Kubly, J.C. deVos, W.R. Persons, R. Staedicke, and R.L. Wright. 1987. Evaluation of varied flow regimes on aquatic resources of Glen and Grand Canyon, final report. [Prepared for Glen Canyon Environmental Studies, Bureau of Reclamation, Flagstaff, Arizona.] Contract # 4-AG-40-01810. Arizona Game and Fish Department, Phoenix.

Makarick, L. (Grand Canyon National Park). 2004. Personal communication with K. Serrato, SWCA Environmental Consultants, Flagstaff, Arizona. February 23.

Marsh, P.C., and M.E. Douglas. 1997. Predation by introduced fishes on endangered humpback chub and other native species in the Little Colorado River, Arizona. Transactions of the American Fisheries Society 126):343–346.

McKinney, T., D.W. Speas, R.S. Rogers, and W.P. Persons. 1999. Rainbow trout in the Lees Ferry recreational fishery below Glen Canyon Dam, Arizona, following establishment of minimum flow requirements. Final Report submitted to Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Cooperative Agreement No. 1425-97-FC-40-22690. Arizona Game and Fish Department, Phoenix.

Miller, D.M., R.A. Young, T.W. Gatlin, and J.A. Richardson. 1982. Amphibians and reptiles of the Grand Canyon. Grand Canyon Natural History Association, Monograph Number 4.

Miller, R.R. 1946. *Gila cypha*, a remarkable new species of cyprinid fish from the Colorado River in Grand Canyon, Arizona. Journal of the Washington Academy of Sciences 36:409–415.

Miller, R.R., and G.R. Smith. 1975. Report on fishes of the Colorado River drainage between Lee's Ferry and Surprise Canyon. Unpubl. Manuscript, collecting report.

Minckley, C.O. 1978. A report on aquatic investigation conducted during 1976-1977, on Bright Angel, Phantom, and Pipe Creeks, Grand Canyon National Park, Coconino County, Arizona. Annual

investigators report submitted to Grand Canyon National Park. Department of Biological Sciences, Northern Arizona University, and Biology Department, Museum of Northern Arizona, Flagstaff.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of the razorback sucker. Pages 303–357 *in* Battle against extinction: Native fish management in the American West, edited by W.L. Minckley and J.E. Deacon. University of Arizona Press, Tucson.

Otis, E.O. 1994. Distribution, abundance, and composition of fishes in Bright Angel and Kanab Creeks, Grand Canyon National Park, Arizona. Master of Science Thesis, University of Arizona, Tucson.

Rathbun, N.L. 1970. Reservoir fisheries investigations: Creel census and plankton studies, *in* Glen Canyon Unit, Colorado River Storage Project, Job Progress Report F-17-R. Arizona Game and Fish Department, Phoenix.

Rowell, K. 2001. Temporal and spatial snapshots of brown trout and rainbow trout pescivory and diet composition during June–December 2000 in Grand Canyon corridor of the Colorado River. Grand Canyon Monitoring and Research Center, Flagstaff, Arizona.

Sellars, R.W. 1997. Preserving nature in the national parks: A history. Yale University Press, New Haven, Connecticut. On-line at: http://www.cr.nps.gov/history/hisnps/npsbooks/sellars.htm.

Sharber, N.G., S.W. Carothers, J.P. Sharber, J.C. deVos Jr., and D.A. House. 1994. Reduced electrofishing-induced injury of rainbow trout. North American Journal of Fisheries Management 14:340–346.

Sjors (Grand Canyon National Park). 2004. Personal communication to K. Serrato, SWCA Environmental Consultants, Flagstaff, Arizona. February 19.

Slack, J.R., A.M. Lumb, and J.M Landwehr,. 1993. Hydroclimatic data network (HCDN): a U.S. geological survey streamflow data set for the United States for the study of climate variation, 1874–1988. Water-Resource Investigations Report 93-4076. U.S. Geological Survey, Washington, DC. Bright Angel data on-line at: ftp://hqwxftp.er.usgs.gov/hcdn92/hcdn/ascii/monthlya/region15/09403000.amm.

Speas, D.W., D.L. Ward, R.S. Rogers, and W.R. Persons. 2003. Salmonid population size, relative density and distribution in the Colorado River in Grand Canyon during 2001 with reference to sapling designs for long-term monitoring: Annual report. Cooperative Agreement 02WRAG0030. Arizona Game and Fish Department, Research Branch, Phoenix.

Streik, J. (Xanterra Parks and Resorts). 2004. Personal communication to K. Serrato, SWCA Environmental Consultants, Flagstaff, Arizona. February 19.

SWCA Environmental Consultants (SWCA). 2003. Feasibility study to determine the efficacy of using a weir in Bright Angel Creek to capture brown trout: Draft. Prepared for Grand Canyon Science Center, Grand Canyon National Park. Prepared by SWCA Environmental Consultants, Flagstaff, Arizona.

SWCA Environmental Consultants (SWCA), and Grand Canyon Wildlands Council. 2006. Bright Angel Creek and Roaring Springs Creek Predator Load Survey and Nonnative Fish Removal Study: Trip Report. Prepared for Grand Canyon National Park.

Townsend, C.R. 1996. Invasion biology and ecological impacts of brown trout *Salmo trutta* in New Zealand. Biological Conservation 78:13–22.

U.S. Bureau of Reclamation (USBR). 2002. Grand Canyon National Park water supply appraisal study. Prepared for Grand Canyon National Park, Grand Canyon, Arizona. Bureau of Reclamation, Phoenix Area Office, Phoenix, Arizona.

U.S. Department of the Interior (DOI). 2002. Proposed experimental releases from Glen Canyon Dam and removal of non-native fish: Environmental assessment. Bureau of Reclamation, National Park Service, and U.S. Geological Survey.

U.S. Fish and Wildlife Service (USFWS). n.d. Conservation strategy for the northeastern Nevada subpopulations of the Columbia spotted frog (*Rana luteiventris*). [Signatories]: U.S. Fish and Wildlife Service, California/Nevada Operations Office; U.S. Bureau of Land Management, Nevada State Office; Nevada Department of Wildlife; Nevada Natural Heritage Program; U.S. Forest Service, Humboldt-Toiyabe National Forest; University of Nevada, Reno.

U.S. Fish and Wildlife Service (USFWS). 2002a. Humpback chub recovery goals: amendment and supplement to the Humpback Chub Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

U.S. Fish and Wildlife Service (USFWS). 2002b. Section 7 consultation on proposed experimental releases from Glen Canyon Dam and removal of non-native fish [biological opinion]. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Geological Survey (USGS). 2004. Calendar year streamflow statistics for Arizona, USGS 09403000 Bright Angel Creek near Grand Canyon, Ariz. On-line at http://waterdata.usgs.gov/az/nwis/annual/calendar_year/?site_no=09403000.

Upper Colorado River Endangered Fish Recovery Program. 2002. Nonnative Fish Control Workshop Summary, conclusions, and recommendations. Program Director's Office, Lakewood, Colorado.

Usher, H.D., W.C. Leibfried, D.W. Blinn, and S.W. Carothers. 1984. A survey of present and future impacts of water depletions and additions on the aquatic and terrestrial habitats of Roaring Springs, Bright Angel, Garden, and Pipe Creeks, Grand Canyon National Park. Final Report to Western Region, National Park Service. Museum of Northern Arizona, Flagstaff, Arizona.

Valdez, R.A., and S.W. Carothers. 1998. The aquatic ecosystem of the Colorado River in Grand Canyon: Grand Canyon data integration project synthesis report. Grand Canyon Monitoring and Research Center, Flagstaff, Arizona.

Valdez, R.A., and R.J. Ryel. 1995. Life history and ecology of the humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Final report to the Bureau of Reclamation, Salt Lake City, Utah, Contract No. 0-CS-40-09110. BIO/WEST Report No. TR-250-08. BIO/WEST, Inc., Logan, Utah.

Van Haverbeke, D.R. 2003. Stock assessment and fisheries monitoring activities in the Little Colorado River within Grand Canyon during 2002. U.S. Fish and Wildlife Service, Arizona Fishery Resources Office, Flagstaff, Arizona.

Van Haverbeke, D.R., and L.G. Coggins. 2003. Stock assessment and fisheries monitoring activities in the Little Colorado River within Grand Canyon during 2001. Final report submitted to the Grand Canyon Monitoring and Research Center. Document Number: USFWS-AZFRO-FL-02-002. U.S. Fish and Wildlife Service, Arizona Fishery Resources Office, Flagstaff, Arizona.

Ward, D. 2002. Standardized methods for handling fish in Grand Canyon research. Draft Report Submitted to Grand Canyon Monitoring and Research Center. Arizona Game and Fish Department.

Ward, R.V.(GRCA). 2004. [E-mail message from R.V. Ward, Wildlife Biologist, Science Center, Grand Canyon National Park, to Lenore Grover-Bullington, Science Center, Grand Canyon National Park. Dated January 14, 2004. Subject line: CRMP: Rana revisited Need Response ASAP.]

Williamson, R.R., and C.F. Tyler. 1932. Trout propagation in Grand Canyon National Park. Grand Canyon Nature Notes 7(2):11–16.

Wright, G.M., J.S. Dixon, and B.H. Thompson. 1933. Fauna of the national parks of the United States: A preliminary survey of faunal relations in national parks. U.S. National Park Service, Washington, D.C.

Yard, M., and L. Coggins. 2003. Non-native fish removal efforts in Grand Canyon: A proposed modification to ongoing activities. Southwest Biological Science Center, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona.

Zimmerman, B., and W.C. Leibfried. 1997. Preliminary results of radio-telemetry of razorback suckers in the Colorado River, western Grand Canyon. Proceedings of the Desert Fishes Council Symposium, November 20–23, 1997, Death Valley National Park, Vol. XXIX.

APPENDIX A
Special Status Species in Coconino County, Arizona

Table A-1. Federally listed and candidate species in Coconino County, Arizona.

Common Name	Scientific Name	Status
Listed		
Apache (Arizona) trout	*Oncorhynchus apache*	Threatened
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Black-footed ferret	*Mustela nigripes*	Endangered
Brady pincushion cactus	*Pediocactus bradyi*	Endangered
California brown pelican	*Pelecanus occidentalis californicus*	Endangered
California condor	*Gymnogyps californianus*	Endangered
Chiricahua leopard frog	*Rana chiricahuensis*	Threatened
Humpback chub	*Gila cypha*	Endangered
Kanab ambersnail	*Oxyloma haydeni kanabensis*	Endangered
Little Colorado spinedace	*Lepidomeda vittata*	Threatened
Mexican gray wolf	*Canis lupus baileyi*	Endangered
Mexican spotted owl	*Strix occidentalis lucida*	Threatened
Navajo sedge	*Carex specuicola*	Threatened
Razorback sucker	*Xyrauchen texanus*	Endangered
San Francisco Peaks groundsel	*Senecio franciscanus*	Threatened
Sentry milk vetch	*Astragalus cremnophylax var. cremnophylax*	Endangered
Siler pincushion cactus	*Pediocactus sileri*	Threatened
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered
Welsh's milkweed	*Asclepias welshii*	Threatened
Gila chub	*Gila intermedia*	Proposed Endangered
Candidate		
Fickeisen plains cactus	*Pediocactus peeblesianus var. fickeiseniae*	Candidate
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate

Source: U.S. Fish and Wildlife Service (USFWS) Web site:
https://fw2azes.r2.fws.gov/specmgt.nsf/165ef5cfbf07a3f107256bff0075fc9d?OpenView.

Table A-2. Wildlife Species of Concern in Arizona (WSCA) in Coconino County, Arizona.

Common Name	Scientific Name	Status
Fish		
Little Colorado sucker	*Catostomus* spp.	WSCA
Humpback chub	*Gila cypha*	WSCA
Roundtail chub	*Gila robusta*	WSCA
Little Colorado spinedace	*Lepidomeda vittata*	WSCA
Apache (Arizona) trout	*Oncorhynchus apache*	WSCA
Razorback sucker	*Xyrauchen texanus*	WSCA
Amphibians		
Plains leopard Frog	*Rana blairi*	WSCA
Chiricahua leopard frog	*Rana chiricahuensis*	WSCA
Northern leopard frog	*Rana pipiens*	WSCA
Lowland leopard frog	*Rana yavapaiensis*	WSCA
Reptiles		
Mexican garter snake	*Thamnophis eques megalops*	WSCA
Narrow-headed garter snake	*Thamnophis rufipunctatus*	WSCA
Birds		
Northern goshawk	*Accipiter Gentilis*	WSCA
Ferruginous hawk	*Buteo regalis*	WSCA
Common black-hawk	*Buteogallus anthracinus*	WSCA
Belted kingfisher	*Ceryle alcyon*	WSCA
Southwestern willow flycatcher	*Empidonax traillii extimus*	WSCA
American peregrine falcon	*Falco peregrinus anatum*	WSCA
Bald eagle	*Haliaeetus leucocephalus*	WSCA
Osprey	*Pandion haliaetus*	WSCA
Pine grosbeak	*Pinicola enucleator*	WSCA
Mexican spotted owl	*Strix occidentalis lucida*	WSCA
Mammals		
Houserock Valley chisel-toothed kangaroo rat	*Dipodomys microps leucotis*	WSCA
Spotted bat	*Euderma maculatum*	WSCA
Western red bat	*Lasiurus blossevillii*	WSCA
Hualapai Mexican vole	*Microtus mexicanus hualpaiensis*	WSCA
Navajo Mexican vole	*Microtus mexicanus navaho*	WSCA

Source: Arizona Game and Fish Department (AGFD) Web site: http://www.azgfd.com/w_c/edits/hdms_species_lists.html).