Biological Assessment

Comprehensive Fisheries Management Plan

Grand Canyon National Park
Glen Canyon National Recreation Area

Coconino and Mohave Counties

May 2013

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LIST OF ACRONYMS

10MPG	Ten migrants per generation
ageSM	Average age at sexual maturity
AIS	Aquatic Invasive Species
ASMR	Age-Structured Mark Recapture Model
AZGFD	Arizona Game and Fish Department
BA	Biological Assessment
BO	Biological Opinion
CFMP	Comprehensive Fisheries Management Plan
cfs	Cubic feet per second
DNFHTC	Dexter National Fish Hatchery and Technology Center
EA	Environmental Assessment
EMU	Ecological Management Unit
ESA	Endangered Species Act
FMZ	Fisheries Management Zone
FR	Federal Register
GCD	Glen Canyon Dam
GCDAMP	Glen Canyon Dam Adaptive Management Workgroup
GCNRA	Glen Canyon National Recreation Area
GMP	Genetic Management Plan
GCNP	Grand Canyon National Park
Gt	Generation Time
LCR	Little Colorado River
LCRMSCP	Lower Colorado River Multi-Species Conservation Program
MSO	Mexican spotted owl
MVP	Minimum Viable Population
NPS	National Park Service
OMPG	One migrant per generation
PAC	Protected Activity Center
PCE	Primary Constituent Element
PIT	Passive-integrated transponder
RM	River mile
TL	Total length
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
YOY	Young of the year

BIOLOGICAL ASSESSMENT

Comprehensive Fisheries Management Plan

National Park Service
Grand Canyon National Park
Glen Canyon National Recreation Area

LOCATION:
Coconino and Mohave Counties, Arizona

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1.0 INTRODUCTION

The purpose of this Biological Assessment (BA) is to analyze the effects of the proposed Comprehensive Fisheries Management Plan (CFMP) for Grand Canyon National Park (GCNP) and the Glen Canyon Reach of Glen Canyon National Recreation Area (GCNRA), and to document whether the CFMP is likely to jeopardize the continued existence of any threatened, endangered or candidate species or adversely modify designated critical habitat. As required under section 7 (a)(2) of the Endangered Species Act (ESA) (16 U.S.C.1531 et seq.[USFWS 1973]), all federal agencies are to use their existing authorities to conserve threatened and endangered species, and consult with the U.S. Fish and Wildlife Service (USFWS), to ensure that their actions do not jeopardize listed species and designated critical habitat. The National Park Service (NPS) is interested in assessing and minimizing the potential for negative impacts to threatened and endangered species and designated critical habitat through this consultation process.

2.0 CONSULTATION HISTORY

The formulation of the CFMP action alternatives began in 2010 when two NPS hosted workshops were held with stakeholders, agencies, and tribes to 1) develop broad goals and site-specific objectives for GCNP, 2) to brainstorm and rank management actions that could be implemented to meet those goals and objectives, and 3) to develop and define Colorado River fisheries management zones. In 2012, a third NPS workshop was held by GCNRA to discuss goals for Glen Canyon fisheries and to obtain feedback from stakeholders related to management of the rainbow trout fishery. Following scoping, 2 additional meetings, interdisciplinary team discussions, and several informal discussions were held among the NPS, Bureau of Reclamation (USBR), Arizona Game and Fish Department (AZGFD), U.S. Geological Survey - Grand Canyon Monitoring and Research Center (USGS-GCMRC), USFWS, and NPS resource specialists to develop alternatives.

March 5, 2012

NPS hosted a meeting with partners and stakeholders in Page, AZ to discuss CFMP management goals for all fish bearing waters between Glen Canyon Dam and Lake Mead

June 1, 2012

NPS mailed project scoping letter to USFWS

June 27, 2012

USFWS responded to project scoping letter and provided NPS with comments

July 12, 2012

Informal meeting with NPS, AZGFD, and USFWS to develop goals, strategies, objectives and triggers for the recreational fishery at Lees Ferry

July 25, 2012

NPS conducted informal meeting with USFWS and AZGFD to develop goals and objectives for native fish activities addressed in this plan

September 19, 2012

NPS conducted informal meeting with USFWS and AZGFD on to discuss and finalize alternatives for the plan

3.0 PURPOSE AND NEED FOR ACTION

Fish communities in GCNP and GCNRA have been substantially altered by human actions, including, but not limited to, the operation of Glen Canyon Dam (GCD) and the introduction of non-native fish species. Tributaries of the Colorado River have natural flow and temperature regimes conducive to native fish spawning and rearing, however the operation of GCD results in colder than natural water temperatures in the mainstem, which limits the ability of native fish to reproduce in the Colorado River. At this time only five of eight native fish species historically present remain within the project area. A CFMP is needed to identify, prioritize, and guide the implementation of management actions that protect and restore native fish communities in accordance with existing laws and NPS Management Policies (NPS 2006b), and make progress toward the recovery of federally endangered fish species. The CFMP is also needed to direct the management of a rainbow trout fishery in the Glen Canyon Reach of the Colorado River within GCNRA to provide a high quality recreational experience in a manner that does not compromise the viability of native fish populations in GCNP downstream.

Historically, the Colorado River and its tributaries within GCNP were home to eight species of native fish; five of which are still present in GCNP today. The river carried heavy sediment loads, and high flows and water temperatures varied tremendously by season. Since completion of the GCD, the water released has been clear and cold, with variations in flow based upon watershed precipitation cycles and water storage and electrical generation needs. The introduction of non-native fish species prior to and following dam construction, water diversions and other factors also altered native fish habitats. The result is three native fish species, Colorado pikeminnow (*Ptychocheilus lucius*), bonytail chub (*Gila elegans*), and roundtail chub (*Gila Robusta*) (Lower Colorado River Distinct Population Segment), have been extirpated from GCNP and GCNRA and are federally listed as endangered or as a candidate (roundtail in the lower basin) for listing in their remaining range. Humpback chub and razorback sucker are currently present in GCNP and are listed as endangered. The three other native fish species occurring in GCNP, speckled dace (*Rhinichthys osculus)*, flannelmouth sucker (*Catostomus latipinnis)* and bluehead sucker *(Catostomus discobolus)* still have healthy populations within the park. A high quality (or "Blue Ribbon" as designated by the AZGFD) rainbow trout fishery has been established in the Glen Canyon Reach of GCNRA, in the cold clear tailwater of the GCD. This fishery is important to both anglers and local businesses that cater to anglers.

Humpback chub reproduction in GCNP relies solely on the Little Colorado River (LCR), and much of the reproduction of native sucker species, such as flannelmouth and bluehead, occur there as well. This is a concern since a single disturbance in the LCR watershed, such as a disease outbreak, invasion of new non-native species, increased abundance of existing non-natives, or a chemical spill at a highway overpass outside the park, would put the viability of GCNP's native fish community at great risk. Establishing additional spawning populations of humpback chub in other areas of the park, while maintaining or enhancing populations of other native fish would improve the resiliency of those species within the park. GCNP also may present unique opportunities to re-establish extirpated species; however, reintroduction activities are not part of this proposed action.

This adaptive CFMP is also needed to maintain the quality of the sport fishery in Lees Ferry and the continued viability of native fish communities in GCNP in the face of changing conditions caused by factors outside the control or scope of the NPS, such as GCD operations, drought or other climatic variations, and new invasions of non-native fish. The quality of the Lees Ferry rainbow trout fishery within GCNRA experiences wide fluctuations due to variation in dam discharge which affects the food base and rainbow trout population dynamics.

Historical monitoring data show that following years with high densities of young-of-year (YOY) trout, the quality (measured by size and condition of the fish) of the trout captured by anglers, as well as angler catch rates, declines. Catch rates of the largest rainbow trout have consistently declined since the 1990s. High trout densities, depending on GCD discharge, may also result in higher rates of downstream movement of non-native rainbow trout into GCNP (Korman et al. 2012). The trout fishery is an important recreational resource for GCNRA and the surrounding area. Visitors come to Lees Ferry from across the United States to fish for trout and enjoy the beauty of the canyon and the river.

Recent Biological Opinions (USFWS 2008, 2011a) on the operations of GCD or coordinated reservoir operations (USFWS 2007a) issued to USBR mandated several Conservation Measures or Reasonable and Prudent Measures to mitigate risks to humpback chub and razorback sucker in GCNP. How and when some of these actions are implemented by the NPS will be determined through this CFMP process. The NPS and USBR have entered into interagency cooperative agreements to implement these measures. The NPS has management authority related to natural resources within NPS units, following consultation with state and federal management agencies, Traditionally Associated American Indian Tribes, and others. These Conservation Measures contribute to NPS management goals. Measures addressed in this plan include:

- Translocations of humpback chub to tributaries outside the LCR and the mainstem Colorado River with associated monitoring
- Expanded brown trout control in Bright Angel Creek and other waterways within GCNP
- Non-native fish control in GCNP tributaries and the mainstem Colorado River
- Conservation of mainstem Colorado River humpback chub aggregations
- Actions to reduce recruitment and emigration of rainbow trout from Lees Ferry
- Razorback Sucker monitoring and augmentation between Lava Falls (river mile 179.2) and GCNP's boundary with Lake Mead

4.0 PROJECT AREA DESCRIPTION

Grand Canyon National Park encompasses approximately 1.2 million acres in northern Arizona on the southern end of the Colorado Plateau (Appendix A, Figure 1), in both Coconino and Mohave Counties. A 277-mile stretch of the Colorado River runs through the park, and thousands of miles of tributary side-canyons are included within its boundaries. The Project Area analyzed in this BA includes all waters in GCNP and GCNRA between GCD and Lake Mead; specifically, the Colorado River and its tributaries in GCNP, and the 15 mile Glen Canyon Reach (located between GCD and the Paria River) and the Paria River in GCNRA. Lake Powell, located above the GCD, is also within GCNRA but is not within the scope of this Environmental Assessment (EA). Lake Mead National Recreation Area located just downstream from GCNP is also outside of the scope of this EA.

Project objectives and project components are defined by Fisheries Management Zones (FMZ), which represent areas with similar habitat conditions, considering the suitability of the area for native fish or sport fish (GCNRA), and the potential for native fish community restoration. Mainstem Colorado River FMZs are based on physical habitat (e.g., water temperature, turbidity), differences in existing fish communities, and presence of major tributaries. For example, the process of delineating tributary and tributary inflow zones was guided by the known presence of aggregations (groups) of humpback chub (Valdez and Ryel 1995).

The park contains several major ecosystems ranging from Mohave desertscrub in the inner canyon to coniferous forests on the North Rim. Climatic conditions in the Grand Canyon region are diverse and elevation-based. Most of the precipitation comes from summer thunderstorms and winter rain and snow. Elevations range from 9,200 feet on the North Rim to 1,200 feet near Lake Mead. At Phantom Ranch in the inner canyon, average annual precipitation is 9 inches, while in the far western canyon precipitation dwindles to 6 inches per year (Houk and Brown 1996).

Riparian communities dominate the inner canyon along the Colorado River, its tributaries, springs and seeps. Riparian scrub communities occur along ephemeral and intermittent systems.

Side canyons throughout the project-area are characterized by cottonwood (*Populus fremontii*) and willow (*Salix* spp.). A few large springs support floras that are quite diverse and contain uncommon species such as scarlet sumac (*Rhus glabra*), water birch (*Betula occidentalis*), and red-osier dogwood (*Cornus stolonifera*). Introduced exotic riparian species also occur in many areas of the inner canyon; species include salt cedar (*Tamarix ramosissima*), camelthorn (*Alhagi maurorum*), perennial pepperweed (*Lepidium latifolium*) red brome (*Bromus rubens*), and weeping lovegrass (*Eragrostis curvula*) (Warren et al. 1982, Houk and Brown 1996, Huisinga et al. 2006).

5.0 AQUATIC CURRENT CONDITION

Aquatic current conditions are described below by FMZ.

Glen Canyon Reach FMZ

The Glen Canyon Reach FMZ of the Colorado River in GCNRA consists of the 15 mile (25 km) section extending downstream from GCD. This reach has been managed by AZGFD as a sport fishery since 1964, when rainbow trout (*Oncorhyncus mykiss*) were first stocked. The fishery has been annually monitored as part of the GCD Adaptive Management Program (GCDAMP) since 1991. In addition to monitoring rainbow trout populations, standardized monitoring also provides data on native fish distribution as well as rare non-native fish detection.

Following completion of GCD in 1964, stocking of catchable and/or fingerling rainbow trout occurred in the Glen Canyon Reach through 1998. Stocking ceased following an increase in natural reproduction and improved recruitment that was likely due to implementation of modified low fluctuating flows at GCD. Following cessation of stocking in 1998, rainbow trout abundance has fluctuated in response to GCD operations (Korman et al. 2012), and rainbow trout populations have been primarily managed through harvest regulations. However, trout suppression flows were also implemented between 2003 and 2005 by the GCDAMP. Following the high flow experiment conducted in spring 2008, a significant increase in the abundance of juvenile rainbow trout was noted. Subsequent monitoring (2009-present) has shown that this cohort has largely persisted through time and in combination with Lake Mead equalization flows, which led to another abundance of juvenile fish in 2011 that was five times higher than the mean juvenile abundance observed from 1991–2010 (Anderson et al. 2012).

The whirling disease pathogen (*Myxobolus cerebralis*) was detected in Glen Canyon Reach rainbow trout in 2007. Annual testing was negative until 2012 when it was found to be more prevalent than in 2007. This pathogen can cause infected fish to swim in an uncontrolled whirling motion and lead to death in rainbow trout. No physical effects or measurable impacts to the trout have been noticed to date.

Standard monitoring conducted by AZGFD has shown that native species in this reach are limited to adult fish (e.g., flannelmouth sucker; McKinney et al. 1999; Rogers 2003). Flannelmouth sucker are commonly captured, with rare occurrences of bluehead sucker (4 total fish) and speckled dace (1fish). These findings indicate that this reach does not provide suitable rearing habitat, likely due to low temperatures resulting in poor survival of eggs (Rogers 2003).

In addition to the population of rainbow trout in the Glen Canyon Reach, several other species of non-native fish have been observed during AZGFD standardized monitoring between 1991 and 2011. Common carp (*Cyprinus carpio*), which may reproduce in the reach in a limited capacity have been the most numerically abundant species after rainbow trout, followed by brown trout (*Salmo trutta,* limited reproduction), walleye (*Sander vitreus*), and striped bass (*Morone saxatilis*), among others occasionally reported.

Marble Canyon FMZ (Colorado River – Paria River to the Little Colorado River Inflow)

The Marble Canyon FMZ includes the reach of the Colorado River between the Paria River riffle (River Mile [RM] 0) to Kwagunt Rapid (RM 56). Rainbow trout numerically dominate this reach, and monitoring within the Marble Canyon FMZ has consistently produced the highest catch rates of rainbow trout within the Colorado River in GCNP (AZGFD data, Makinster et al. 2010, Bunch et al. 2012). While some recruitment of rainbow trout may occur in Marble Canyon, evidence suggests the majority of rainbow trout within Marble Canyon are produced in the Glen Canyon Reach, and recruitment is heavily influenced by dam releases (Korman et al. 2012). Flannelmouth sucker and humpback chub are also present in this reach. Evidence of successful reproduction of humpback chub has been noted at Fence Fault Spring near RM 30 (Valdez and Masslich 1999).

In May 2012, non-native trout control was approved for the Paria to Badger Rapid reach (approx. 8 miles) of the Colorado River within the Marble Canyon FMZ to benefit native fish, particularly endangered humpback chub, in GCNP (USBR 2012). Two experimental trips were scheduled for 2012; however, the detection of whirling disease resulted in the cancellation of those trips due to concerns about spreading the disease to other sites through live removal and re-stocking of rainbow trout. The future implementation of this activity is under discussion. Up to ten trout removal trips per year were approved, however the project has yet to be initiated. In addition, trout removal at the LCR was approved, and would occur if trout abundance and humpback chub survival and abundance triggers are met. As of 2012, the AZGFD restricts the harvest of trout to six fish by anglers between the Paria riffle and Navajo Bridge (RM 4.2) within this FMZ. There is no limit on the harvest of trout or other non-native sport fish in the remainder of the reach.

Several actions in the CFMP described below were included as humpback chub conservation measures in the latest Biological Opinion (BO) for the operation of GCD (USFWS 2011a). The CFMP is meant to compliment non-native rainbow and brown trout control actions in Marble Canyon (which includes the LCR Inflow) as included in the USBR Non-native Fish Control EA (USBR 2012). The main source of brown trout in GCNP, including Marble Canyon and the LCR Inflow is likely Bright Angel Creek.

The high flow experimental protocol actions approved in the recent USBR EA (2012) also may impact humpback chub habitat and result in increased trout production in the Glen Canyon Reach FMZ, however triggered non-native fish control at the LCR Inflow (USBR 2012) was designed to offset these impacts. High, steady, equalization flows may also increase trout production in the Glen Canyon Reach FMZ (Korman et al. 2012). During 2011, high snowpack in the upper basin of the Colorado River resulted in dam discharge maintaining flows above approximately 20,000 cubic feet per second (cfs) for the spring and summer months resulting in a large cohort of rainbow trout (Anderson et al. 2012).

Little Colorado River and Inflow FMZ

The LCR and Inflow FMZ includes the area of the Colorado River between Kwagunt and Tanner rapids (RM 56 to 68.5). The LCR and Inflow FMZ supports the largest remaining humpback chub aggregation in GCNP and throughout the range of the species. Trends in the LCR humpback chub aggregation are discussed in more detail below. The LCR itself is a major spawning and rearing area for flannelmouth and bluehead suckers.

Native species numerically dominate the catch during monitoring within the LCR itself; however, several non-native fish species are present. During the most recent monitoring event (October 2012), in order of decreasing number of catches, humpback chub, speckled dace, bluehead sucker, flannelmouth sucker were native fish captured, followed by fathead minnow (*Pimephales promelas*), common carp, channel catfish (*Ictaluras punctatus*), black bullhead (*Amierus melas*), and four other species represented non-native fish (Stone 2012).

Humpback chub and rainbow trout dominated the LCR and Inflow FMZ in 2011 (Pine et al. 2011 Nearshore Ecology Study update), but non-native fish species were numerically dominant between 2003 and 2006 (Coggins et al. 2011). Non-native fish control was implemented in the LCR and Inflow FMZ between 2003 and 2006, with one trip in early 2009, effectively reducing trout within this reach, while a system-wide decline in trout abundance was occurring. Warmer water temperatures in the GCD discharge and strong recruitment of native fish during this time coincided with control efforts, confounding the results of non-native fish control (Coggins et al. 2011). Yard et al. (2011) found that non-native trout could consume a large number of small sized native fish in the reach, but population-scale impacts of this predation are unknown.

Apparent survival of juvenile humpback chub has been monitored for the past 4 years as part of the Nearshore Ecology Study within this reach, however, trout numbers were lower than pre-removal levels (Bunch et al. 2012). Preliminary results indicate mean survival rates for the first three years were between about 37% and 67% (Finch 2012). Juvenile humpback chub survival in the mainstem, as well as trout abundance, continue to be monitored through USGS-GCMRC. In addition to the juvenile humpback chub that are reared in the LCR itself, a large proportion of the juvenile humpback chub have been hypothesized to rear in the mainstem within the LCR Inflow recently (B. Pine and C. Walters, personal communication, to B. Healy, July 11, 2012). To mitigate tribal concerns related to euthanizing trout within GCNP, and particularly at the LCR inflow, future trout control has been focused on the Paria-to-Badger reach by the GCDAMP and the ongoing efforts at Bright Angel Creek and Shinumo Creek by the NPS.

Translocations of humpback chub to a previously unoccupied area upstream of Chute Falls within the LCR was initiated by the USFWS beginning in 2003 and continuing to July 2012 to expand the distribution of the species as well as provide a relatively predator and competitor free rearing opportunity. Growth rates observed upstream of Chute Falls were considered atypical (higher) relative to growth rates found for downstream areas of the LCR (Stone 2006). Beginning in 2008, collections of humpback chub for tributary translocations outside of the

LCR, as well as collections for the establishment of the refuge population at Dexter National Fish Hatchery and Technology Center (DNFHTC) have occurred in the LCR. Approximately, 3,000 juvenile humpback chub were collected and removed from the LCR between 2008 and 2012 to facilitate these efforts, and the latest population estimates indicate that the humpback chub population has continued to increase during this time (S. Vanderkooi, USGS, personal communication, to B. Healy, 9/28/2012). A population viability model was developed by a workgroup led by Dr. W. Pine III, University of Florida (Pine et al. *in press*), to inform managers planning collections of humpback chub from the LCR, how to minimize risk of impact to the source population.

Bright Angel Creek and Inflow FMZ

The Bright Angel Creek and Inflow FMZ encompasses Bright Angel Creek and its tributaries as well as the area of the Colorado River between Zoroaster Rapid (RM 84.7) and Horn Creek Rapid (RM 90.2). Bright Angel Creek consists of 13 miles of perennial, fish-bearing stream, flowing into the Colorado River at approximately RM 87.6. While headwaters remain cold, water temperatures fluctuate seasonally with air temperatures in lower Bright Angel Creek and the temperature regime is sufficient to support native fish (NPS unpublished data). Monitoring of the mainstem Colorado River and tributaries has shown that Bright Angel Creek and its surrounding inflow have been an important area for the persistence of both native and non-native fish populations in the Colorado River. Investigations for establishing a second population of humpback chub in Grand Canyon identified Bright Angel Creek as a potential translocation site, while the surrounding inflow (RM 85-91) historically included 1 of 9 humpback chub aggregations (Valdez et al. 2000). The latest BO for the operation of GCD (USFWS 2011a) also identified Bright Angel Creek as one of three tributaries to focus humpback chub translocation efforts, as well as expanded brown trout control.

The humpback chub was described as a species from a specimen collected from an area near Bright Angel Creek, and the inflow was considered a humpback chub aggregation by Valdez and Ryel (1995); however the species has only been collected rarely in recent years at this location. This FMZ currently supports the highest density of non-native brown trout in GCNP, and Bright Angel Creek is likely the most important spawning area for brown trout in the project area. Nevertheless, flannelmouth sucker also spawn in Bright Angel Creek during the spring (Weiss et al. 1998). The creek also supports bluehead suckers, speckled dace, and rainbow trout (Otis 1994). Adult brown and rainbow trout in spawning condition have been captured entering Bright Angel Creek from the mainstem during the fall (Leibfried et al. 2004, Sponholtz et al. 2010, Omana-Smith et.al 2012).

Efforts targeting trout for removal from Bright Angel Creek began with a feasibility study in 2002, but the implementation of trout control was sporadic and lacking in long-term experimental design and continuity of data collection. The feasibility study lasted 64 days from November 18, 2002- January 21, 2003, yielding 423 brown trout and 188 rainbow trout (Leibfried et al. 2004). Following the completion of the Bright Angel Creek Trout Reduction Environmental Assessment and Finding of No Significant Impact (NPS 2006a), the fish weir was re-installed and operated by USFWS on two occasions in 2006 and 2007 (Appendix A, Figure 2). During the first installation of 71 days from November 11, 2006- January 23, 2007, 54 brown trout and 36 rainbow trout were removed from the creek (Sponholtz et al. 2010). The weir was installed a second time for 36 days from April 6- May 11, 2007; no trout were captured during this time period (Sponholtz et al. 2010).

In October 2010, GCNP reinitiated the weir and electro-fishing project in Bright Angel Creek (Omana-Smith et al. 2012). Electro-fishing removal of both rainbow and brown trout using three-pass depletion was conducted in the first 600 meters of Bright Angel Creek above the weir beginning in October 2010, then for approximately 1500 meters at the end of January 2011, followed by approximately 2700 to 2800 meters in October 2011 and January 2012, respectively. A general decline in trout was observed over time in the lower 600 meters of Bright Angel Creek (Appendix A, Figure 3), but a large flood also occurred during September 2011 that may have impacted trout abundance as well. Among all trips, an average of between 70% and 91% of non-native trout were removed using three-pass depletion electro-fishing (Healy et al. 2013). Bluehead sucker captures increased after January 2011; however, too few individuals were captured in the October 2010 and January 2011 trips to generate population estimates for comparison to more recent data for trend analysis. Bluehead suckers are being tagged with passive-integrated transponders (PIT) during sampling events to facilitate survival analysis in the future.

During the winters of 2010-2011 and 2011-2012, the weir was operated by NPS personnel between the third week in October and the first week in February; and 105 brown trout and 107 rainbow trout, and 32 brown trout and 55 rainbow trout, were captured and removed each year, respectively. No native fish were captured. Trout tagged in the mainstem and re-captured in the weir in the past two seasons came from as far away as RM 119 and RM 30.5 for brown and rainbow trout, respectively, but most fish were tagged within a few miles of the Bright Angel Creek mouth (RM 87.7). To increase efficiency in the fall-winter season of 2012-2013, weir operations were installed earlier in the season (September 29, 2012), and were operated until early March 2013 to fully encompass the trout spawning seasons.

Analysis of the seasonal feeding habits of rainbow and brown trout captured and removed from Bright Angel Creek indicated that piscivory was an important feeding mode for trout, with average piscivory rates of 18% and 5% for brown and rainbow trout, respectively (Whiting et al. 2012). Native fish were between 0.18% and 18.9% of the diet of rainbow trout and between 4.8% and 47.6% of the diet of brown trout in November, January, June, and September (D. Whiting, University of Missouri, unpublished data). In addition to potential predation effects by non-native trout, particularly brown trout, upon native fishes, there was substantial overlap in diet between trout and native fishes, indicating the potential for competition (Whiting et al. 2012). Rainbow trout diets overlapped more with native fish than brown trout.

Shinumo Creek and Inflow FMZ

The Shinumo Creek and Inflow FMZ includes the Shinumo Creek watershed as well as the Shinumo Inflow area of the Colorado River between Bass and Shinumo Rapids (RM 107.7 to RM 108.6). Shinumo Creek is a small (about 10 cubic-feet/sec baseflow), clear tributary stream with barrier falls just above its confluence with the Colorado River, thereby isolating acceptable humpback chub habitat from most non-native predatory fish in the Colorado River, such as brown trout. Rainbow trout, speckled dace, and bluehead sucker inhabit Shinumo Creek and are present above and below the barrier falls. The Shinumo Inflow area contains an established humpback chub aggregation, which was estimated to support around 57 fish in the mid-1990s (Valdez and Ryel 1995). Along with Havasu and Bright Angel Creeks, Shinumo Creek was evaluated as a potential humpback chub translocation site by Valdez et al. (2000), and continues to be one of the focal streams for translocations and non-native fish control in the latest GCD Biological Opinion (USFWS 2011a).

Under an experimental framework (Trammell et al. 2012), a total of 902 humpback chub were translocated to Shinumo Creek between 2009 and 2011; the first translocations of humpback chub within GCNP. Data collected during monitoring were used to assess the survival, growth, and movements of translocated humpback chub to determine the applicability of tributary translocations as a conservation tool. The annual growth rates of translocated humpback chub in Shinumo Creek reported by Spurgeon (2012) are comparable to, or higher than growth rates for humpback chub elsewhere in GCNP (Appendix A, Figure 4) (Robinson and Childs 2001, Healy 2013).

The latest mark-recapture population estimates (Appendix A, Figure 5) for humpback chub in Shinumo Creek and remote PIT-tag antenna data (Spurgeon 2012) indicate high emigration rates following releases. However, in September of 2010 and 2011 a number of humpback chub from the Shinumo translocations were re-captured primarily in the Shinumo Creek aggregation in the Colorado River during mainstem aggregation sampling (USGS-GCMRC and USFWS, unpublished data). In September 2012, the NPS assisted USGS and USFWS in sampling the Shinumo Inflow using hoop nets as part of a pilot mainstem aggregation mark-recapture study. Data collected by the NPS in the Shinumo Inflow during September and data from the February, June, and September 2012 Shinumo Creek monitoring trips revealed, 179 unique translocated humpback chub (20% of 902 released) were re-captured, including 82 fish ≥ 200 mm total length (TL) (Healy 2013). Humpback chub that reach approximately 200 mm TL are considered to be "adults."

In conjunction with Shinumo Creek monitoring trips beginning in 2009, rainbow trout control has been implemented using a variety of gear types, mainly backpack electro-fishing (upstream of translocation areas) and angling equipment (in translocation reaches). Trout control was deemed essential in translocation streams (USFWS 2008, 2011a); to potentially reduce the effects of competition and predation upon the survival of translocated humpback chub. No rigorous trend analysis could be conducted with angling catch data; however rainbow trout and native fish abundance were estimated using electro-fishing depletion analysis for upstream reaches. Multiple-pass depletion electro-fishing (30-35 Hz Pulsed DC, 300-350 Volts) was applied during each monitoring trip beginning in June 2010.

As a result of electro-fishing removal, rainbow trout abundance declined consistently through 2011, and then increased by June 2012, followed by a decrease by September 2012 (most recent data; Appendix A, Figure 6). Rainbow trout population size structure also shifted toward smaller size classes, and by September rainbow trout larger than 150 mm TL (age-1+ fish) were rare compared to other years (Appendix A, Figure 7). These results are not unexpected as larger fish are more susceptible to capture by electro-fishing, and the removal of adults may illicit a positive compensatory response in juvenile survival (Meyers et al. 2006). Diet studies of rainbow trout in Shinumo Creek found the smallest rainbow trout that consumed fish was 120 mm TL, but the majority (75%) of rainbow trout that contained native fish in their stomachs was over 200 mm TL (Spurgeon 2012). Therefore, reductions in larger rainbow trout are assumed to benefit native fish survival.

Humpback chub apparent annual survival was estimated using Cormack-Jolly-Seber models (Lebreton et al. 1992) for the 2009, 2010, and 2011 translocated cohorts of humpback chub. Apparent survival estimates are a function of true survival and site fidelity, meaning the model cannot differentiate between fish that died or fish that simply emigrated out of the stream. The highest annual survival among the three cohorts of translocated humpback chub was found in 2011, (0.41, Healy 2013; versus 0.22 and 0.20, for 2009 and 2010, respectively, Spurgeon 2012) which occurred during a period when trout abundance was lowest in Shinumo Creek. The 2011 translocation cohort also had the smallest average size at release (87 mm TL), which would be assumed to be the most susceptible to predation, but smaller fish were also less likely to leave following release as was seen in 2009 and 2010 (Spurgeon 2012). Therefore, a lower emigration rate for the 2011 cohort, combined with fewer potential competitors or predators, may have resulted in doubling the apparent survival.

Due to concerns related to the risk of injury from repeated electro-fishing to native species, bluehead sucker survival was evaluated using mark-recapture methodology (Cormack-Jolly-Seber models, Lebreton et al. 1992). Bluehead sucker annual apparent survival (fish >150 mm TL) was 0.46 between June 2010 and 2011, and 0.48 between June 2011 and 2012 (Healy et al. 2013), which is comparable to rates reported for bluehead sucker in GCNP, and to results of several other studies summarized in Walters et al. (2012). Apparent survival increased with fish total length, despite the higher likelihood of injury to large fish due to electro-fishing found in some studies (see Snyder 2003). Thus, using the electro-fishing methods applied during 2010-2012, it appears that the effects of electro-fishing may not substantially impact resident bluehead sucker.

High emigration rates of translocated humpback chub (Spurgeon 2012) and the potential for predation or competition by non-native rainbow trout remains a concern for the establishment of a spawning aggregation within Shinumo Creek. Although no reproduction of humpback chub has been detected through September 2012, because estimated growth rates for translocated fish meet or exceed those estimated for juvenile humpback chub within the LCR or the Colorado River, Shinumo Creek may provide a suitable rearing opportunity for humpback chub even if reproduction does not occur. Recent preliminary estimates of the abundance of humpback chub in the Shinumo Inflow indicate that translocations to Shinumo Creek have resulted in substantial increases in the population in the mainstem (Persons and Van Haverbeke 2012), and subsequently emigrating fish may continue to augment the Shinumo Inflow aggregation (Valdez and Ryel 1995) in the Colorado River.

Havasu Creek and Inflow FMZ

The Havasu Creek and Inflow FMZ includes Havasu Creek from the NPS boundary with the Havasupai Indian Reservation downstream to the Colorado River (approximately 3.5 miles, NPS land), and the Colorado River including the Havasu Creek inflow between RM 155 and 157. Havasu Creek physio-chemical habitat conditions and baseline fish community data are described in Trammell et al. (2012). In summary, water temperatures range from between 9.7 to 26.2 °C (Voichick and Wright 2007), and habitat is similar to the LCR. Stream flow averages about 64 cfs, which is approximately 25 -33% of the base flow in the LCR (summarized in Valdez et al. 2000). During baseline surveys in 2010 and 2011, the fish community was composed of speckled dace, bluehead sucker, rainbow trout, and humpback chub, which was found in 2011, but not in 2010 surveys (Trammell et al. 2012).

The Havasu Inflow was identified as a humpback chub aggregation area by Valdez and Ryel (1995), and continued to support humpback chub through September 2012 (USGS/USFWS unpublished data). Native species such as flannelmouth and bluehead suckers have been observed spawning in the mouth of Havasu Creek (B. Healy, personal observation). Striped bass, a predatory non-native fish presumably emigrating from Lake Mead, have been observed in the Havasu Inflow area in the past (Valdez and Leibfried 1999), as well as the occasional channel catfish (USGS-GCMRC, unpublished data).

Havasu Creek was identified by Valdez et al. (2000) as the most favorable of the GCNP tributaries outside of the LCR for translocations of humpback chub. In an initial pilot Havasu Creek translocation study (see Trammell et al. 2012), with a similar design to the initial Shinumo Creek translocation experiment described above, 243 and 300 juvenile humpback chub (mean size 87 and 124 mm TL, respectively) were released in June 2011 and May 2012, respectively. As of the most recent monitoring trip in October 2012, annual apparent survival of the 2011 cohort in Havasu Creek was 0.49 (0.41 – 0.56, 95% Confidence Interval, Healy 2013), and some translocated fish were also captured in the mainstem (R.Van Haverbeke, personal communication, USGS/USFWS unpublished data) that were not included in the survival analysis. Annual growth rates also exceeded those found in the LCR by Robinson and Childs (2001 [see Appendix A, Figure 4 for growth comparison], Healy 2013). In May 2012, male humpback chub that were translocated the previous year were captured in spawning condition, however no evidence of reproduction was found in October 2012 (Healy 2013). Insufficient data are available to assess the survival of the 2012 cohort, because only one monitoring trip has occurred since their release. However, between PIT-tagging prior to their release and the next monitoring trip (i.e., May to October), growth rates of the 2012 cohort appear to be comparable to those found for the 2011 cohort (0.35 mm/day vs. 0.42 mm/day) (Spurgeon 2012, Healy 2013), and a large number of the 2012 cohort were also captured in October (89 individuals or 30%) (Nelson et al. 2012a). The last of three translocations to Havasu Creek in this initial experiment will occur in May 2013, followed by monitoring in October, according to Trammell et al. (2012), however additional translocations are proposed in the proposed action of the CFMP described below.

Lower Colorado River FMZ

The Lower Colorado River FMZ includes the reach of the Colorado River between Lava Falls (RM 179.2) and the GCNP boundary with Lake Mead. The transition between riverine habitat and lentic habitat varies with the level of Lake Mead Reservoir. The normal full pool elevation for the reservoir is upstream of Separation Canyon at RM 239.6. However, in recent years, low reservoir levels have resulted in riverine habitat to Pearce Ferry (approx. RM 280), where a large rapid formed in the past few years.

Physical habitat in the Lower Colorado River FMZ is characterized by relatively complex habitat with backwaters, vegetated shorelines, deep runs, eddies, and riffles downstream of Lava Falls, but complexity declines below RM 253, where backwaters are less common, the structure of the channel is dominated by homogenous run habitat, with few riffles or pools, and eroding banks are common (Speas and Trammell 2009). In a review of habitat and biological conditions of this reach for potential razorback sucker establishment, Valdez et al. (2012) found that sufficient habitat and temperatures were available to support spawning of razorback sucker in April/May, but large floodplain wetlands that support larval rearing in other systems may be more limited upstream of Lake Mead. Nevertheless, backwaters are available in lower GCNP and support rearing of other native sucker species.

The generalized fish community within this FMZ is described in Hilwig et al. (2009) and in Valdez et al. (2012a) and summarized here. Between Lava Falls and Diamond Creek, the fish community has been mainly composed of native species (speckled dace, flannelmouth and bluehead suckers) while downstream areas, particularly below Bridge Canyon (RM 235) have been dominated by non-native fish species including common carp, red shiner (*Cyprinella lutrensis*), and others. Non-native fishes have been particularly abundant where riverine habitats were transformed into lentic habitats due to increased elevation of Lake Mead, or where the channel was transformed by sediment deposition. Predatory non-native fish species, such as striped bass and channel catfish, are commonly captured in this reach as well, and Lake Mead is a potential source for these species.

A small (n=5, 95% CI = 4-16) humpback chub aggregation identified by Valdez and Ryel (1995) has also consistently been found near Pumpkin Spring (RM 212 – 213) within this FMZ. Recent preliminary estimates by Persons and Van Haverbeke (2012) indicate that the Pumpkin Spring aggregation has increased in number in recent years (>100 individuals, 2010-2011). YOY or juvenile humpback chub have also been captured from backwaters in this FMZ (see Fig. 3 of USFWS 2011a; NPS unpublished backwater seining data, 2009), however the natal origin of these fish is unknown.

In 2012, a total of four sonic-tagged razorback suckers were detected within GCNP between the park boundary and Quartermaster Canyon (Bio/West/Bureau of Reclamation, unpublished data), and an untagged individual adult male in spawning condition was captured near Spencer Canyon (RM 246) in October 2012. Whether razorback sucker spawn within GCNP is unknown, but reproduction has been confirmed through the capture of larval razorback suckers in the Colorado River inflow of Lake Mead over the past 3 years (Kegerries and Albrecht 2011).

Colorado River FMZ

This Colorado River FMZ encompasses the mainstem Colorado River throughout the project area, outside areas specifically included in other FMZs. In general, outside of the Bright Angel Creek Inflow, the Colorado River within this FMZ is composed of mainly native fish (flannelmouth sucker, speckled dace, bluehead sucker), but common carp, fathead minnow, and rainbow trout are also common in some areas (Hilwig et al. 2009). Recent reporting indicates that rainbow and brown trout catch rates, as well flannelmouth sucker, have increased consistently in this reach since 2006-07 (Bunch et al. 2012).

This FMZ contains humpback chub aggregations that are not necessarily associated with tributaries, including the Lava Chuar to Hance (RM 65.7-76.3), Stephen Aisle (RM 114.9 - 120.1), and Middle Granite Gorge (RM 126.1 -129) aggregations (Valdez and Ryel 1995). Outside of the LCR, the Middle Granite Gorge aggregation was considered the largest within Grand Canyon, with an initial population estimate of 98 fish (95% CI 74-153, Valdez and Ryel 1995).

Several larger fish-bearing perennial tributary inflows, including Tapeats Creek (RM 133.7) and Kanab Creek (RM 143.5), flow into this FMZ. Tapeats Creek is dominated by non-native trout, while Kanab Creek contains a mix of non-native (fathead minnow, common carp, rainbow trout, etc.) in the lower 1.4 miles of stream and native species upstream (NPS/SWCA, Inc., unpublished data). Habitat in Tapeats Creek is more conducive to cold-water species such as trout, due to cold, year-round water temperatures (Voichick and Wright 2007), and the stream may be a source of non-native trout to the mainstem. The Kanab Creek watershed extends beyond the NPS boundary, and has been suggested as a source of warm-water non-native fish to GCNP (Hilwig et al. 2009).

6.0 PROPOSED ACTION

The NPS proposes to implement a CFMP for all fish bearing waters in GCNP and GCNRA below GCD. The CFMP would provide an adaptive, programmatic framework for meeting fisheries management goals and objectives in the Colorado River and its tributaries in GCNP and the Glen Canyon Reach of GCNRA. The CFMP would give direction for NPS actions that support the conservation and recovery of native fish communities, including the recovery goals of threatened and endangered species. The CFMP also establishes NPS management direction for the recreational rainbow trout fishery in the Glen Canyon Reach below GCD. Due to uncertainties in future GCD operations and changing habitat conditions, an adaptive management approach will be taken to implement fisheries management actions to meet fisheries goals and objectives.

Desired Conditions

Desired conditions are defined as detailed, measurable descriptions of what a resource will look like after management goals have been achieved over the long-term. The desired conditions for fisheries resources are what managers will strive to achieve over the long-term, and are critical to developing more specific, time-limited objectives for projects or programs that would be implemented through the fisheries management plan. Desired conditions for fisheries in the project area are listed below.

Project-Wide Desired Conditions

- Potential sources of introductions of non-native species are identified and prioritized based on introduction risk, and monitored. Control actions are implemented when necessary preventing or minimizing introduction and establishment of new non-native species.

- Fish assemblages in tributaries, where existing natural physical habitat and flow and temperature regimes support native fish reproduction, rearing, and recruitment (i.e., resident populations are supported), are dominated by native species and populations are self-sustaining.

Glen Canyon National Recreation Area below Glen Canyon Dam Desired Conditions

- A highly valued recreational rainbow trout fishery is maintained with minimal emigration downstream to GCNP, such that:
    - Opportunities are present for anglers to have a memorable fishing experience in a unique setting.
    - Glen Canyon Reach habitat supports a rainbow trout population with a size structure indicative of a stable population, with minimal emigration downstream into Marble and Grand Canyons.
    - Native fish communities are maintained in the Paria River and to the extent practicable, given dam operations, the Colorado River.

Grand Canyon National Park Desired Conditions

- The LCR humpback chub aggregation is stable, USFWS Recovery Goals and demographic factors are met or exceeded, and recovery factor criteria for HBC in the Lower Basin Recovery Unit are met consistent with USFWS Recovery Plans
- Humpback chub aggregations persist in one or more tributaries where each population is stable (i.e., recruitment rate greater than or equal to adult mortality rate) and at carrying capacity, with genetic integrity maintained. Note: Genetic integrity in small tributary populations may be maintained through periodic supplemental stocking if needed
- Population redundancy for HBC outside the LCR exists in one or more tributary inflow or other mainstem aggregations, where reproduction and recruitment are occurring such that the combined tributary, tributary inflow, or mainstem populations, are equal to or greater than minimum viable population size. Note: Minimum viable population size to be determined by USFWS
- Management of GCNP fish communities supports razorback sucker conservation efforts in Lake Mead and contributes toward species recovery

- Recruitment of razorback sucker in upper Lake Mead and the Lower Colorado River FMZ is documented and supports maintenance and expansion of Lake Mead's razorback sucker population
- Threats of predation or competition to native species from existing non-native species are managed to promote native species spawning, rearing, survival, and dispersal
- In the mainstem Colorado River, existing (non ESA listed) populations of native fish including speckled dace and flannelmouth and bluehead suckers are stable
- Extirpated fish species have been reintroduced, where appropriate, following reintroduction feasibility studies, and populations are self-sustaining

Goals

Goals are statements of direction or intent for management of fisheries communities within the Colorado River and Paria River in the Glen Canyon Reach of GCNRA and throughout GCNP. The goals listed below are meant to be the basis for defining the desired conditions of fisheries resources.

Fisheries management goals for the Colorado River and the Paria River in GCNRA are:

GCNRA Goal 1: Maintain a highly valued recreational rainbow trout fishery with minimal emigration of rainbow trout downstream to GCNP;

GCNRA Goal 2: Restore and maintain healthy, self-sustaining native fish communities, native fish habitat, and the important ecological role of native fishes to the extent possible;

GCNRA Goal 3: Foster meaningful tribal relations and integrate tribal knowledge and perspectives into park management decisions and practices;

GCNRA Goal 4: Prevent further introductions of non-native (exotic species).

Fisheries management goals for the Colorado River and its tributaries in GCNP are:

GCNP Goal 1: Meet or exceed population and demographic goals for the appropriate recovery unit applicable to GCNP for existing ESA listed fish species, maintain self-sustaining populations, and restore distribution of those species to the extent practicable;

GCNP Goal 2: Maintain or enhance viable populations of existing native fish, and restore native fish communities and native fish habitat to the extent practicable;

GCNP Goal 3: Restore self-sustaining populations of extirpated fish species including Colorado pikeminnow, razorback sucker, bonytail, and roundtail chub as appropriate and to the extent feasible (if feasibility studies determine each species can be reasonably restored without impacting existing ESA-listed species);

GCNP Goal 4: Foster meaningful tribal relations and integrate tribal knowledge and perspectives in to park management decisions and practices;

GCNP Goal 5: Prevent further introductions of non-native (exotic) aquatic species, and remove, when possible, or otherwise contain individuals or populations of non-native species already established in GCNP.

Objectives

Measureable objectives are the time-sensitive benchmarks used to determine whether progress is made towards meeting goals, and to determine whether the purpose and need for the plan are being met. Objectives are listed either as project-wide objectives, or by FMZs (described above) which represent areas with similar habitat conditions, consider the suitability of the area for native fish or sport fish (GCNRA), and the potential for restoration.

Project-Wide Objectives

Objective 1: Monitor for, and respond to, new invasions and/or expanded range or relative abundance of non-desirable fish (e.g., brown trout, catfish, smallmouth bass) or Aquatic Invasive Species (AIS) with feasible control measures.

Objective 2: Determine the natal origin or source of introductions of all warm-water (e.g., bass, catfish) and high-priority cold-water non-native fish species (i.e. brown trout), and develop and implement plans to control sources of those species.

Objective 3: Implement a beneficial use program for non-native species removed for the purpose of native fish community restoration or ESA-listed fish recovery consistent with NHPA Section 106 consultation with Traditionally Associated Indian Tribes.

Objective 4: Conduct inventory of aquatic communities in tributaries where data are unavailable, and develop and implement restoration plans when necessary.

Objective 5: Implement a monitoring plan sufficient to assess changes in fish populations related to management actions or natural factors.

Glen Canyon Reach Objectives

GCNRA Objective 1: Maintain angler catch rates of at least 10 fish per day greater than 14 inches, with an angler catch rate above 1.0 fish per hour.

GCNRA Objective 2: On an annual basis, maintain proportion of rainbow trout less than six inches between 20 – 80% of the population, and maintain at least moderate condition of catchable rainbow trout size (greater than 12 inches).

GCNRA Objective 3: Maintain a rainbow trout fishery representative of the range of age classes.

GCNRA Objective 4: Promote take of all undesirable non-native fish by anglers including but not limited to brown trout, walleye, bass, and sunfish to prevent potential impacts to rainbow trout fishery as well as to populations of native fish species.

<u>Grand Canyon National Park Fisheries Management Zone-specific Objectives</u>

GCNP – Little Colorado River and Inflow FMZ

Objective 1: Maintain adult abundance of humpback chub at or above the latest population estimate (6,000 to 10,000 adults, Coggins and Walters 2009), or above the minimum viable population size, as determined by the USFWS, whichever is greater.

Objective 2: Maintain stable or increasing populations of bluehead sucker, flannelmouth sucker, and speckled dace.

GCNP – Bright Angel Creek and Inflow FMZ

Objective 1: Reduce and maintain abundance of non-native trout at approximately 20% of baseline, or lower, over five years to allow for enhanced populations of native resident species.

Objective 2: Maintain stable or increasing populations of bluehead sucker, flannelmouth sucker, and speckled dace (i.e. existing native fish).

Objective 3: Following reduction of non-native species (brown trout), begin experimental humpback chub translocations to establish spawning aggregation, with the mature population increasing toward the estimated carrying capacity in Bright Angel Creek or toward minimum viable population size in the Bright Angel Inflow aggregation, while maintaining genetic integrity.

GCNP – Shinumo Creek and Inflow FMZ

Objective 1: Over the next 10 years, establish a spawning aggregation of humpback chub, with the mature population increasing toward the estimated carrying capacity in Shinumo Creek or towards minimum viable population size in the Shinumo Inflow aggregation, while maintaining genetic integrity.

Objective 2: Investigate alternative release techniques and management strategies to improve retention and rearing of translocated humpback chub in Shinumo Creek and other tributaries where translocation may occur.

Objective 3: Maintain stable or increasing populations of bluehead sucker and speckled dace.

GCNP – Havasu Creek and Inflow FMZ

Objective 1: Over the next 10 years, establish a spawning aggregation of humpback chub, with the mature population increasing toward the estimated carrying capacity in Havasu Creek, or towards minimum viable population size in the Havasu Inflow aggregation, while maintaining genetic integrity.

Objective 2: Maintain stable or increasing resident populations of bluehead sucker, speckled dace, and other native species.

GCNP – Lower Colorado River FMZ

Objective 1: Develop and implement a management strategy for razorback sucker in the Lower Colorado River FMZ, coordinated with Lake Mead National Recreation Area.

GCNP – Colorado River FMZ

Objective 1: Maintain stable or increasing populations of bluehead sucker, flannelmouth sucker, and speckled dace.

Objective 2: Evaluate the potential for reintroducing native extirpated species and begin developing implementation strategies as practicable.

The NPS CFMP preferred alternative proposes to:

- Continue with outreach efforts to prevent the accidental or purposeful introduction of new non-native aquatic species within the project area. Outreach efforts would also encourage the harvest of all non-native fish species by anglers.
- Translocate humpback chub from the LCR to tributaries outside the LCR, and to areas in the mainstem Colorado River. A remote PIT tag antenna would be maintained at Shinumo Creek and Bright Angel Creek to monitor outmigration of translocated humpback chub.
- Implement a comprehensive mechanical removal (netting, electro-fishing, weir use, angling) program for trout in and around Bright Angel Creek.
- Respond to emergencies of new non-native species introductions requiring immediate action using mechanical removal means.
- Implement control of non-native species in tributaries, with efforts focused on areas where translocations occur.
- Remove and euthanize all high-risk, non-native predatory fish species captured during monitoring efforts, unless specific research objectives designed to improve efficiency of control efforts warrant their tagging and release. These species include brown trout (*Salmo trutta*), catfish species (including bullheads), bass and sunfish (Centrarchidae), striped bass (Moronidae), cichlids (Cichlidae), perch and walleye (Percidae), and other rare non-native species not previously detected in GCNP or the Glen Canyon Reach of GCNRA.

- Targeted volunteer angling trips to remove trout from Marble Canyon.
- Translocations of native fish (bluehead sucker) to tributaries if declines occur related to non-native fish control using electro-fishing.
- Beneficially use non-native fish removed, according to the results of consultation with Traditionally Associated Indian Tribes under Section 106 of the National Historic Preservation Act.
- Experimentally stock sterile, triploid rainbow trout in the Glen Canyon Reach to maintain angling opportunities if a severe decline in rainbow trout occurs.
- Implement an adaptive management approach to management or augmentation of razorback sucker in the Lower Colorado River FMZ (Lava Falls [RM 179.2] to the Lake Mead Inflow). This includes sonic-telemetry studies of adults released below Lava Falls, increased sampling of larval or small-bodied fish to better assess the current status of razorback sucker, and the implementation of a monitoring and augmentation plan, if determined to be appropriate based on results of studies and in consultation with the USFWS, Lake Mead Razorback Working Group, and the Lower Colorado River Multi-Species Conservation Program.

Table 1. Comparison of current NPS conditions and proposed NPS modifications of the Comprehensive Fisheries Management Plan, Grand Canyon National Park, 2012.

Alternative Elements	Current Condition	Proposed Modifications
Project –Wide:		
Outreach/AIS prevention	Educational outreach will continue; current operations will remain unchanged	Current operations would be expanded to prevent the introduction of new AIS. Efforts would also encourage harvest of all non-native fish species by anglers.
Expanded non-native species detection monitoring	No	Expanded to the Lower Colorado River FMZ (below Lava Falls), Kanab, and Havasu creeks
Emergency Response to new/expanded introductions	Emergency response procedures will remain in place; current operations will remain unchanged	Current operations will remain unchanged
Remove incidental captures	Minimal, only rare non-natives removed	Catfish, brown trout, bass, sunfish, percids, and rare non-natives will be removed when captured
Proactive warm-water non-native fish control	No	Current operations will remain unchanged
Beneficial use of removed non-native fish	Removed fish will go toward a beneficial use	Current operations will remain unchanged
Extirpated species reintroduction feasibility studies	No	Yes
Angler Harvest Regulations	Current operations will remain unchanged	Current operations will remain unchanged

Marble Canyon FMZ (GCNP Zone-specific):		
Targeted volunteer angling – facilitated river trips with mandatory harvest of rainbow trout by angling volunteers	No	Non-commercial trips within Marble Canyon and downstream (Paria Riffle to RM 60)
Little Colorado River and Inflow FMZ (GCNP Zone-specific):		
Juvenile humpback chub collected for tributary translocations (approx.. 500 per year)	No	Collected fish will be reared in a hatchery facility, marked, and released in tributaries or downstream areas of the Colorado River within GCNP
Bright Angel Creek and Inflow FMZ (GCNP Zone-specific):		
Tributary Non-native fish control electro-fishing	None	NPS 2006a experimental actions will be extended for an additional 5+ years
Weir operations (fall/winter)	None	NPS 2006a experimental actions would be extended for an additional 5+ years
Inflow boat electro-fishing trout control	No	One trip/year (November) will be conducted over approx. 20 nights
Humpback chub translocations	No	Translocations will be initiated if trout removal targets are met
Native fish translocations (triggered)	No	If triggered
Shinumo Creek and Inflow FMZ (GCNP Zone-specific):		
Tributary non-native fish control electro-fishing and/or angling	None	Applied to up to 4 km (2.5 miles) of stream during 2-3 monitoring trips/year. No electro-fishing would be conducted May or June
Humpback chub translocations	None	According to genetics augmentation plan; minimum 2 more years; would include 4 km (2.5 miles) of habitat
Remote PIT tag antenna maintenance	Existing antenna will be removed	Antenna will be maintained and used 3 more years
Native fish translocations (triggered)	No	Expanded to include another 1 km (.6 miles) of stream, below White Creek
Havasu Creek and Inflow FMZ (GCNP Zone-specific):		
Humpback chub translocations	No	According to genetics augmentation plan; minimum 2 more years
Native fish translocations (triggered)	No	Only as needed per established criteria
Tributary non-native fish control (netting/angling)	No	Incidental to monitoring

Mainstem/Inflow non-native fish control (boat electro-fishing/angling) for striped bass, catfish	No	Only as needed per established criteria
Lower Colorado River FMZ (GCNP Zone-specific):		
Razorback sucker augmentation/ management (Lava Falls to Lake Mead)	Only limited monitoring will be conducted	Phased approach: 1) Sonic tagging/tracking adults, larval fish study. 2) Assess results, develop long-term monitoring/ augmentation plan, if appropriate.
Coordinate trips to harvest catfish and other warm-water species using angler volunteers below Diamond (Lava Falls to Lake Mead)	No	Current operations will remain unchanged
Colorado River FMZ (GCNP Zone-specific)		
Fisheries monitoring – USGS-GCMRC, AZGFD, USFWS, NPS	Current monitoring programs would continue unchanged	Adaptive management will be based on existing monitoring programs
Humpback chub translocations to aggregations	No	2011 USFWS conservation measures would be implemented
Glen Canyon Reach FMZ (Lees Ferry)		
Management of existing trout size structure/density	Current operations will remain unchanged	Current operations will remain unchanged
Experimental stocking triploid/sterile trout	No	Sterile rainbow trout will be stocked upstream of the Paria Riffle, if triggers are met. Angler catch rates will be monitored and regulated.
Other Tributaries		
Non-native control – mechanical (netting, angling, electro-fishing)	Only if emergency response is triggered, or pending further Section 106, NEPA, and ESA compliance, if necessary	Current operations will remain unchanged

Project Description

Humpback Chub and Native Fish Translocations

Humpback chub translocations were included among the conservation measures in the most recent BO for the Operation of GCD Including High Flow Experiments and Non-Native Fish Control (USFWS 2011a). This project element includes the collection of juvenile humpback chub, rearing the fish in a hatchery facility until they are large enough to mark with individually identifiable tags, and then release them in tributaries or downstream areas of the Colorado River within GCNP.

Other native fish, such as bluehead sucker, may be translocated, or collected as larvae from tributaries and reared in a hatchery and then released following the development of a translocation and augmentation plan, which would incorporate methods described below, and NPS Management Policies (NPS 2006b) direction for genetics management. Additional interagency and tribal consultation, as well as NEPA compliance would be necessary prior to these activities.

Collection and Rearing of Fish for Translocations
As in past years, humpback chub would be collected from the LCR during summer prior to the onset of monsoons (early-mid July), or if summer collection trips are cancelled or ineffective due to flooding, a secondary collection period would occur in the fall (October or November). Trips would be up to 5 days in length, consisting of up to 6-8 biologists and volunteers. Equipment and staff would be flown into and out of previously established camps and landing areas via helicopter (up to 4 flights to/from camps from the Salt Helipad near the head of Salt Canyon). Collections would target YOY fish using netting methods, with up to 500 individuals collected per year.

Juvenile or YOY humpback chub collected from the LCR would be flown from collection areas and transferred to a hatchery truck for delivery to a hatchery facility approved by USFWS. Fish would be quarantined and treated for parasites and diseases following standard hatchery procedures, held until they are at least approximately 100 mm (5-10 months), and then tagged and released the following spring or summer. The number of individuals collected per year would be dependent on population viability modeling (PV model) (Pine et al. *in press*), genetic augmentation needs, and hatchery rearing capacity. Initially (first 5 years, due to initial hatchery capacity), approximately 500 individuals would be collected for translocations per year. Any additional future collection plans would be evaluated using the PV model developed by Pine et al. (*in press*). For example, larger numbers of larval fish (e.g. < 20-30 mm) may be targeted for collection if capture and rearing protocols are developed.

Translocation/Release of Fish
In late spring or early summer (the following year after collections), tagged humpback chub would be flown from the NPS South Rim Helibase in aerated coolers to release sites (single flight). Initially (first 5 years), Havasu, Bright Angel, and Shinumo Creeks would be targeted for translocations, however, other tributaries, or areas of the mainstem Colorado River where sufficient habitat is determined to exist may be considered for translocations in the future.

Colorado River mainstem aggregations of humpback chub (Valdez and Ryel 1995) would be targeted for translocations. Translocations in Shinumo Creek would be expanded upstream of previous efforts to include another 1 km of stream, below White Creek, to increase carrying capacity. Translocation of humpback chub to Bright Angel Creek would only occur if brown trout were reduced from 2010 baseline estimates by more than 80%. Following USFWS guidance (USFWS/DNFHTC 2010), initial translocations of at least 200 fish would occur to each release area for a minimum of 5 years, and up to 10 years (1 generation, minimum of 1,000 fish), depending on the availability of fish for translocations.

Genetic Augmentation

The USFWS recently published a genetic management plan (GMP) for captive and translocated humpback chub in the Lower Colorado River Basin (USFWS-DNFHTC 2010), which includes the GCNP population. For translocation projects, the GMP provides guidance to maintain gene flow and minimize the loss of genetic diversity in translocated populations. The GMP recognized that the recommendations provided would not cover all management situations and that population management is a dynamic process, and thus an adaptive management strategy based on the GMP guidelines is appropriate.

The GMP recommends a minimum of 200 fish translocated every year for 5 years (or every other year for 10 years) to each new area, and that sufficient translocations occur to span a generation to establish a population with a natural age and size distribution. Based on the equation for calculating generation time: Generation time (Gt) = ageSM + (1/d), where ageSM is the average age at sexual maturity, and d is death rate; the generation time for humpback chub is 10 years, using ageSM = 4 years, and d = 1 - 0.82 (R. Valdez, personal communication, August 3, 2012). The survival rate of 0.82 is the latest estimate for the LCR population of humpback chub based on the Age-structured Mark-recapture model (ASMR) (R. Valdez, pers. comm.). This guideline assumes no emigration and 100% survival of translocated individuals, which has not been observed in translocations to GCNP tributaries or in translocations within the LCR to isolated upstream reaches (e.g. above Chute Falls). Additionally, past genetics principles incorporated into humpback chub recovery planning included estimates of the proportion of the adults passing genes on the next generation to minimize genetic risks (USFWS 2002a). However, these values are unknown for humpback chub, and in the past were estimated based on known values for other fish species, and effective population size can vary even within multiple populations of a single species (see Phillipsen et al. 2011).

Given uncertainties in carrying capacity and future emigration and survival rates in translocated populations, as well as uncertainties in effective population size (work in progress, USFWS), an adaptive management approach to genetic management is taken in the CFMP. An alternative accepted principle for managing gene flow in populations was proposed by Mills and Allendorf (1996), which assumes that an exchange rate of one migrant per generation (OMPG) among populations is sufficient. However, given the uncertainties above, and potential deviations from assumptions made during the development of the OMPG rule, Mills and Allendorf (1996) recommended that a more conservative guideline of up to 10 migrants per generation (10MPG) may be more appropriate to maintain genetic diversity. Thus, a model was developed for adaptive genetic management of translocated populations that incorporated the 10MPG rule, as well as survival, emigration, and growth rates observed in translocated populations in GCNP (B.

Healy, R. Valdez, M. Trammell, unpublished data). Based on simulations using parameters derived from monitoring Havasu and Shinumo Creek translocation projects, including the average apparent survival estimates of 0.28 (average of the 2009, 2010, and 2011 cohorts) and 0.49 for humpback chub translocated to Shinumo and Havasu Creeks (Spurgeon 2012, Healy 2013), respectively, between 456 and 85 total additional humpback chub would need to be translocated over 10 years (1 generation) to meet the 10MPG rule.

Following the GMP guidance, a minimum of 200 individuals would be maintained in each translocation area over the long-term if reproduction is documented. Adaptive genetic management and additional augmentation would be informed by the model discussed above, with parameters derived from data collected during annual monitoring of population dynamics in translocated populations as discussed in Trammell et al. (2012). The model could be adapted in future years to incorporate effective population size estimates currently under investigation by the USFWS-DNFHTC. Tissues for genetic analysis would be collected from all translocated fish, and each year class found in translocated populations.

Adaptive Management, Outcomes, and Triggers

Various outcomes to the translocation of humpback chub into tributaries or mainstem areas would be anticipated. For humpback chub, three potential outcomes would be expected, and these would include:

1) Establishment of a second spawning and recruiting population in the mainstem or tributary,
2) Sufficient survival and growth to provide a grow-out area to augment the local mainstem aggregation,
3) Failure of at least 20% of humpback chub to survive in the creek or adjacent mainstem aggregation for at least one year.

The NPS and its cooperators would strive to meet outcome 1, which would contribute the most toward goals for recovery of humpback chub, however outcome 2 would result in benefits to humpback chub as well. Outcomes 2 and 3 would be evaluated 5 years following initial translocations, however it may require 10 years or more (Pine et al. *in press*) to determine whether outcome 1 has been observed. Indicators for evaluation of the potential outcomes for humpback chub objectives include:

a. Retention of translocated humpback chub over the first year
b. Similar or increased survival of juveniles relative to the LCR and mainstem Colorado River near the LCR inflow
c. Similar or increased growth rates relative to the LCR and mainstem Colorado River near the LCR inflow
d. Contribution to and retention of translocated fish to an adjacent mainstem aggregation
e. Evidence of successful reproduction (presence of larval or YOY fish)
f. Evidence of local recruitment

Outcome 1 would be achieved if monitoring showed that indicators e) or f) have been detected. This outcome would trigger additional translocations of humpback chub to maintain genetic integrity, consistent with genetics management principles found in USFWS/DNFHTC (2010), and Mills and Allendorf (1996). In summary, a minimum adult population of 200 fish would be maintained, and at least 10MPG, or ten additional adult fish, would be necessary to introduce into the population to maintain genetic integrity (Mills and Allendorf 1996). Accounting for the number of fish remaining and surviving to adult size based on observations made during translocations at Shinumo and Havasu Creeks (2009-2012) (Spurgeon 2012, Healy 2013), between approximately 45 and 1000 total fish may need to be released in translocation sites over a generation, which is approximately 10 years for humpback chub (R. Valdez, SWCA consultations, personal communication, August 3, 2012).

Outcome 2 would be achieved if monitoring found a), b), c), or d) occurred for translocated populations. This outcome may be considered an intermediate outcome, which would be expected to lead to outcome 1, which would be determined through continued monitoring. Alternatively, the particular translocation project, for which outcome 2 has been observed for 10 years, may simply be considered as a rearing opportunity for humpback chub, in which case, a minimum of 200 adult fish would be maintained.

Outcome 3 would signify a failure of translocations in partially or fully meeting management zone objectives and translocations to a particular tributary or other mainstem area would cease. If at least indicator a) had not been achieved consistently after 5 years of translocations, and no other indicators had been observed, then translocations to a particular area would be considered a failure.

Monitoring and Non-native Fish Control

Monitoring survival, growth of individual fish, and occurrence of reproduction and recruitment is a key component of this project element and adaptive management. Monitoring and augmentation of translocated populations may also be necessary to maintain genetic integrity (USFWS/DNFHTC 2010).

For tributary translocations, netting and/or electro-fishing may be necessary in both the tributary and adjacent mainstem areas to determine humpback chub survival. Monitoring and continued control of non-native rainbow trout would also be employed during monitoring efforts at Shinumo Creek at least twice per year, including a winter river raft electro-fishing trip (1 week in February). No multiple-pass electro-fishing would occur in tributaries containing resident or transient populations of bluehead or flannelmouth sucker or humpback chub during April, May, or June to coincide with spawning periods. A previously installed, temporary fish detection system would be maintained for 3 more years to test release methods on retention of humpback chub and monitor movements of translocated fish at Shinumo Creek. A PIT tag antenna system was determined to be infeasible at Havasu Creek prior to humpback chub translocations there in 2010, and a PIT tag antenna system may be considered at Bright Angel Creek or other areas prior to future translocations. Additional compliance may be necessary prior to PIT tag antenna installation at other sites outside of Shinumo Creek.

Native Fish Reintroduction, Augmentation, and Management

Feasibility studies for the reintroduction of extirpated fish species would be conducted over the life of the CFMP, and if the potential exists additional NEPA and ESA compliance would be initiated prior to the development of a reintroduction plan. At this time, Colorado pikeminnow would be prioritized for the implementation or initiation of reintroduction feasibility studies. Potential hybridization between bonytail, roundtail and humpback chub preclude the introduction of additional chub species (*Gila* species) where humpback chub may occur.

Razorback Sucker Augmentation and Adaptive Management – Lower Colorado River FMZ
Recent detections of razorback sucker within GCNP that were tagged and released in Lake Mead, and their return to the lake suggests that razorback sucker may utilize habitat within the project area at least occasionally. Further, as razorback sucker spawn and recruit in the inflow area of Lake Mead, it is also possible that populations will expand on their own into the Lower Colorado FMZ.

A three-year study began in 2010 in the inflow area of Lake Mead, and confirmed that wild razorback suckers were spawning and recruiting into the population of fish within Lake Mead (Kegerries and Albrecht 2011). Recent data confirms that razorback sucker sonic-tagged in Lake Mead have moved into the Lower Colorado River FMZ at Quartermaster Canyon (R. Keggeries et al., Bio-West Inc, unpublished data). In addition, an untagged, ripe male was captured in the Lower Colorado River FMZ in October 2012 (A. Bunch, AZGFD, personal communication). In coordination with the Lake Mead Razorback Sucker Workgroup, led by the USBR under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) a management strategy for razorback sucker was developed (Valdez et al. 2012b). The release of sonic-telemetry tagged razorback sucker is proposed, along with additional inventories to determine whether habitat is suitable for razorback sucker in the Lower Colorado River FMZ. Potential outcomes that may be observed related to razorback sucker suitability studies in the Lower Colorado River FMZ over the life of the CFMP may include:

1) Razorback sucker are present and reproducing in the Lower Colorado River FMZ
2) Razorback sucker are present in substantial numbers in the Lower Colorado River FMZ, but are not reproducing or recruiting in the Colorado River
3) Suitable habitat for razorback sucker is available, but few individuals are present and no reproduction is occurring

The following phased adaptive management strategy would be implemented, beginning in 2013:

- Phase I, years 1-3: Conduct fish community survey of lower GCNP, including larval fish, large-bodied fish, and sonic-tagged razorback sucker to describe/quantify the fish community and identify potential spawning sites.
- Phase II, end of year 3: Evaluation of data collected during years 1-3 to identify a) whether sonic-tagged fish remained in the area, b) razorback sucker presence/absence, and c) whether the Lake Mead population is expanding into GCNP.
- Phase III, year 4: If Phase II results show substantial numbers (25%) of sonic-tagged razorback sucker remain, or razorback sucker are present in the area (larvae or other unmarked adults), or there is evidence of the Lake Mead population expanding into GCNP, then establish a long-term monitoring program for razorback sucker in the Lower Colorado River FMZ, and;

a) Suspend plans to augment razorback sucker in the Lower Colorado River FMZ if there is evidence of increasing abundance of razorback sucker or expansion of the Lake Mead population into the Lower Colorado River FMZ (Outcome 1); or
b) Convene established workgroups (see Valdez et al. 2012b) to recommend continuing augmentation plan and implementation when there is a continued presence of razorback sucker in Lake Mead but no evidence of expansion into GCNP (Outcome 2 or 3).

<u>Non-native Fish and Aquatic Invasive Species (AIS) Introduction Prevention, Detection, and Control</u>

Outreach
Outreach via the development and placement of signs at likely access points, website development, interpretive talks, and other materials or practices would be expanded to prevent the accidental or purposeful introduction of new non-native aquatic species within the project area. Outreach efforts would also encourage the harvest of all non-native fish species by anglers.

Detection Monitoring
Current fish and invertebrate monitoring conducted by cooperating agencies would continue at likely introduction areas in the Glen Canyon Reach, the LCR, and in the mainstem Colorado River upstream of Lake Mead. However, detection programs would be added or expanded to include other geographical areas considered high-risk pathways for non-native species introductions. Monitoring programs in tributary watersheds that include lands beyond the NPS boundary, and thus may be sources for new introductions including Havasu Creek and Kanab Creek would be added, with monitoring taking place on NPS managed lands. Havasu Creek would be monitored using multiple fish-sampling gear types up to twice per year in conjunction with humpback chub monitoring (no additional trips), and Kanab Creek's lower sections would be monitored early summer and fall to detect non-native species in conjunction with river trips supporting monitoring efforts at Shinumo Creek or other tributaries. Fish monitoring efforts would be expanded in Colorado River FMZ to detect invading or expanding populations of non-native fish from Lake Mead in conjunction with efforts to monitor for razorback sucker.

When new introductions of non-native fish species are encountered, depending on the level of threat and magnitude of response needed, control measures may take place through emergency response procedures (described below).

To the extent possible, NPS would coordinate with other management agencies, tribes, and/or land owners in watersheds that extend beyond GCNP or GCNRA to evaluate risk of new introductions from those areas and develop cooperative efforts to deter future invasions.

Removal of Incidental Captures
Unless specific research objectives warrant their tagging and release, all high risk non-native predatory fish species captured during monitoring efforts throughout the project area, would be euthanized and put to beneficial use according to consultation with Traditionally Associated Tribes when possible. These species include brown trout, catfish species (including bullheads),

bass and sunfish, striped bass, cichlids, perch and walleye, and other rare non-native species not previously detected in GCNP or the Glen Canyon Reach of GCNRA.

Source Identification
Tissues or bony parts of high-risk non-native fish removed incidental to monitoring efforts would be analyzed to determine source when possible and when funding is available. For example, the microchemistry of humpback chub otolith bones has been used to determine natal origin in GCNP (Hayden et al. 2012). Additionally, the NPS would engage resource managers (AZGFD, USFWS, and tribes) or landowners in the watersheds immediately adjacent to GCNP and GCNRA to prevent future introductions of non-native species. Information sharing would assist managers in targeting areas if/when expanded or emergency control efforts are needed.

Targeted Angling – Rafting Trips
In cooperation with the AZGFD, non-commercial rafting trips would be coordinated to remove cold-water non-native fish, primarily rainbow trout, using angling equipment within Marble Canyon and downstream to approximately RM 60. Volunteer anglers would be required to keep and beneficially use all non-native fish captured.

Emergency Rapid Response to Detected Expansion or New Non-Native Species Introduction
Consistent with NPS Director's Order 12 (NPS 2011), for emergencies, including a) the discovery of an expansion in distribution or abundance of an existing high risk non-native species, particularly in sensitive areas for native fish (e.g. Havasu Creek or LCR inflow areas), or b) the new detection of a rapidly spreading AIS or non-native fish species, the Superintendent could approve a temporary, short-term, targeted removal effort to treat known occurrences of the new threat using mechanical methods including angling, electro-fishing, and passive (e.g.. trap nets) or active (e.g. seining) netting. Simultaneously, additional compliance and consultation may be necessary if a long-term response, such as maintenance control, were essential.

Comprehensive Brown Trout Control
NPS fisheries biologists would expand past trout reduction activities (weir and tributary electro-fishing) (NPS 2006a) in Bright Angel Creek by extending removal efforts to the Bright Angel Creek inflow area of the Colorado River. Both brown and rainbow trout, and other non-native fish encountered, would be removed during these efforts to meet goals and objectives identified in the CFMP. Experimental mechanical control methods listed below would be implemented for 5 consecutive years, and then re-evaluated to determine whether reduction targets (80% reduction) had been achieved.

This project element would include:

- Multiple-pass electro-fishing using two motorized electro-fishing boats for up to 20 nights, sufficient to reduce trout by 80%, between Zoroaster and Horn Creek rapids (RM 84.7 - 90.2; approximately five miles of the Colorado River). A single trip is proposed to occur during the fall months.
- Weir (fish trap) installation downstream of Phantom Ranch in Bright Angel Creek during the spawning seasons for rainbow (fall/winter/spring) and brown trout (fall) to capture mature adults entering the creek to spawn. The weir may be installed beginning in

September and extending into the spring months (April), depending on the ability of the equipment to withstand higher spring snow melt runoff flows.

- Backpack electro-fishing by an eight person crew would encompass all fish-bearing waters within the Bright Angel Creek watershed (approx. 13 miles), for between 70 and 100 days over the fall and winter months. One remote camp may be necessary near Bright Angel Canyon near the headwaters of Bright Angel Creek.
- Removal of brown trout incidentally throughout the project area during monitoring (see above), and encouraging the harvest of brown trout by anglers.
- Mechanical removal (electro-fishing, angling, netting, etc.) of brown trout may be employed in other tributaries or areas of the mainstem if natal origin studies conducted during the first five years indicate other areas are sources of brown trout in GCNP, and system-wide declines in brown trout are not observed initially. Efforts would be focused where individuals are aggregating in specific areas, and their populations can be feasibly controlled and suppressed using mechanical removal methods (additional compliance may be necessary).

Monitoring would be implemented to determine the success of the project during and following the initial five year effort. Monitoring metrics include abundance, size structure, recruitment of native and non-native species, and survival of bluehead sucker (may require additional sampling occasions). Depletion monitoring using electro-fishing gear would be the initial focus for both the tributary and Colorado River, however additional netting may be conducted in both areas in coordination with the AZGFD, USFWS, and USGS-GCMRC to improve survival or abundance estimates for native fish. Multiple-passes of electro-fishing would be implemented over the same areas to calculate a population estimate based on depletion statistical analysis.

Adaptive Management, Outcomes, and Triggers

Non-native fish control is proposed to benefit native fish species in GCNP (Goal 2), however the response of native fish to non-native control actions, and the level of control necessary to illicit a positive response in native populations is somewhat difficult to predict, and variable (Trammell 2005). While measures are taken to reduce the likelihood of injury to individual native fish during electro-fishing, injuries or deaths of fish can and do occur on occasion. The uncertainty relates to whether the benefits to native fish populations from removal of non-native predators outweigh the potential effects of injury to individual fish through electro-fishing and subsequent handling prior to release. Additionally, environmental factors (e.g. climate, flooding, drought, occurrence of fire, etc.) that are not influenced by active management may have an overriding influence in driving population dynamics of native fish in waters within the project area. Potential outcomes for non-native fish removal activities for both existing native and non-native fish in tributaries may include:

1) Native fish survival, abundance, and recruitment, is maintained or increases as non-native fish species abundance is reduced in tributaries,
2) Native fish survival, abundance, and recruitment declines as non-native fish species abundance is reduced in tributaries, or
3) Non-native fish abundance does not decline in tributaries with the implementation of control methods.

Non-native fish, bluehead sucker, and speckled dace population dynamics would be monitored in all tributaries where non-native fish control actions would be implemented. A monitoring program is currently in place for these species in Havasu, Shinumo, and Bright Angel Creeks. Flannelmouth sucker are not generally found as residents in tributaries. Flannelmouth sucker trends in GCNP and the Glen Canyon Reach of GCNRA are monitored during AZGFD's Colorado River mainstem electro-fishing trips between Lees Ferry and Lake Mead, as well as during GCNRA electro-fishing monitoring efforts. Only abundance indicators are proposed for monitoring speckled dace due to the lack of feasible methods to assess individual survival for the species. The outcomes for each non-native control project would be assessed after five years using indicators including:

a. Abundance (number of fish/unit area) or trend in catch rates (i.e., catch-per-unit-effort)
b. Survival (estimated via mark-recapture)
c. Recruitment (either number of new fish tagged, or % of population < 100 or 150 mm)
d. Size structure (i.e., numbers of fish at each size class)

Fisheries managers would strive for Outcome 1 for each project, and if achieved, non-native control projects may proceed at an appropriate level of "maintenance" control effort, which could include the continuation of the current effort, or a reduced level of control effort.

If after five years, Outcomes 2 or 3 are indicated through monitoring, non-native fish control projects would cease and be re-evaluated for at least one year. Data and trends from the previous years as well as newly emerging science and technologies would be reviewed, and methods may be adapted for the future to achieve Outcome 1. Translocations of other native species may be considered if it is determined that declines in those species are severe, and augmentation is needed. Following review and depending on the most appropriate course of action proposed, additional compliance may be necessary.

During the evaluation phase of non-native fish control projects, the NPS would share data, results, and future plans with collaborating agencies, Traditionally Associated Tribes, stakeholders, and interested members of the public through outreach.

Beneficial Use of Non-native Fish Removed

The NPS would employ a beneficial use policy for all non-native fish removed from the project area, following consultation with Traditionally Associated Tribes. Beneficial use policies would be employed in such a manner to reduce the risk of transfer of disease from one location to another, consistent with state and federal laws and statutes. Non-native fish euthanized during non-native control efforts would be put to beneficial use, to the extent possible, and within the limits of health and safety for human consumption, fed to captive wildlife at wildlife rehabilitation centers, or recycled back into the ecosystem such as through returning fish back into the water once they are euthanized.

Glen Canyon Rainbow Trout Management

Experimental Stocking of Sterile Trout
In coordination with the AZGFD, (subject to approval by the Arizona Game and Fish Commission, and availability of sterile fish), experimental stocking of sterile, triploid rainbow trout (female only, multiple age-classes, stocking plan to be determined) would be initiated specifically if:

- Recruitment (young fish produced in the wild) is low for multiple years: rainbow trout recruits (fish < 6 inches) comprise less than 20% of the fish community during AZGFD fall monitoring events for more than three consecutive years; or
- AZGFD electro-fishing estimates of relative abundance are less than 1.0 fish/minute for two consecutive years of sampling; or
- If angler catch rates in Lees Ferry decline to ≤ 0.5 rainbow trout/hour, and average size is < 14 inches for two consecutive years. In other words, if the density of trout and angler catch rates are very low, but the average size of those fish is very large, then goals for the fishery would have been met and no sterile triploid trout stocking would be necessary.

The stocking of sterile rainbow trout would be limited to the Glen Canyon Reach within GCNRA, upstream of the Paria Riffle only. Stocking would likely continue until electro-fishing relative abundance estimates and/or angler catch rate criteria listed above are met. Relative abundance of all fish caught would be greater than one fish/minute or angler catch rates exceeded 0.5 fish/hour for two consecutive years. Depending on conditions that may lead to a potential decline in the fishery in the future, sterile trout may be stocked for a number of years until the fishery objectives are met, at which time stocking would potentially cease until triggers are met, and stocking would be re-initiated. Stocking could be reinitiated as appropriate, following GCNRA's rainbow trout adaptive management strategy described in the next paragraph.

Adaptive Management
A stocking and monitoring plan including number and size of sterile trout stocked would be developed before sterile trout stocking would be implemented. At a minimum, sterile fish released would be marked to assess their performance. Short and long-term outcomes, monitoring metrics, and an adaptive management framework would be defined and determined. For example, experimental stocking of triploid rainbow trout would include extensive marking of hatchery fish to monitor multiple metrics including, but not limited to, return to anglers, movement, growth, and survival. If marked fish are not returned/captured by anglers as intended or are found moving out of the stocking-approved area (i.e., into Marble Canyon/Little Colorado River area), stocking would be reassessed. Reassessment could include altering location of stocking, size of fish stocked, timing of stocking, and number of fish stocked. If stocking was deemed sustainable at a given level (i.e., acceptable catch rates, minimal impacts outside the fishery), it would continue. Essentially, the experiment would be successful if, through triploid trout stocking, fisheries objectives could be maintained and an adequate control of the rainbow trout population could be achieved while minimizing impacts on resources outside the fishery. If, through monitoring of stocked fish, there is minimal return to anglers or unacceptable levels of impact on resources outside the fishery, stocking would cease.

7.0 SPECIES ACCOUNTS

This evaluation focuses on federally listed species and habitat within GCNP, as GCNRA biologists have determined ***no effect*** to listed species within the Glen Canyon Reach (email concurrence request sent by R. Palarino to GCNRA 10/24/2012).

Occurrence records for nine federally listed species and two species that are candidates for listing have been recorded within GCNP (Table 2). Critical habitat for three of the nine listed species has also been identified within GCNP. In addition to federally listed species, GCNP contains habitat for many plant and animal species that are considered Species of Special Concern (state and/or tribal listed species, or species formerly listed as candidate Categories 1 and 2 by the USFWS). While only federally listed species will be evaluated in this BA, the others were reviewed by park biologists as part of the NEPA analyses in the EA (see Appendix B for a complete listing of special status species within GCNP).

This consultation is an evaluation of potential effects to the California condor, Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, Yuma clapper rail, humpback chub, and razorback sucker from implementation of a Comprehensive Fisheries Management Plan. The Mexican spotted owl and California condor are widespread in the park and occur (or have the potential to occur) in proximity to actions proposed in this plan. Locations and suitable habitat for southwestern willow flycatchers, western yellow-billed cuckoo, and Yuma clapper rails are restricted to the Colorado River corridor and its tributaries and side canyons with sufficient hydrology to support vegetative characteristics that could contain flycatcher territories or marsh communities of sufficient size to support rails. Other federally listed species in the GCNP have more restricted habitat requirements and/or known locations do not occur in areas affected by this fisheries management plan. In October 2012, USFWS concurred that this plan was not anticipated to affect the Kanab ambersnail, desert tortoise, relict leopard frog, or sentry milk-vetch. Therefore those species are not included in this Biological Assessment.

Table 2. Federally listed threatened and endangered species in Grand Canyon National Park, 2012. Those in bold text are analyzed in this document.

Name	Species	Status
Wildlife		
California Condor	***Gymnogyps californianus***	**Endangered** Experimental Non-Essential (10j) population designated for Southwest Reintroductions Considered **Threatened** in National Parks within 10j Area
Humpback Chub*	***Gila cypha***	**Endangered**
Mexican Spotted Owl*	***Strix occidentalis lucida***	**Threatened**
Razorback Sucker*	***Xyrauchen texanus***	**Endangered**
Southwestern Willow Flycatcher	***Empidonax traillii extimus***	**Endangered**
Western Yellow-billed Cuckoo	***Coccyzus americanus***	**Candidate**

Yuma Clapper Rail	***Rallus longirostris***	**Endangered**
Kanab Ambersnail	*Oxyloma haydeni*	Endangered
Desert Tortoise	*Gopherus agassizii*	Threatened
Relict Leopard Frog	*Rana onca*	Candidate
Plants		
Sentry Milk-vetch	*Astragalus cremnophylax cremnophylax*	Endangered

*Species with designated critical habitat in GCNP

8.0 SPECIES EVALUATION

Impacts to species were analyzed using the best site-specific data available for species locations and distributions within, or near the boundaries of, Grand Canyon National Park.

Listed Species Determination

For the purposes of section 7 consultation under the Endangered Species Act, the following definitions are used when determining the level of anticipated effect for each listed species and its habitat (USFWS & US National Marine Fisheries Service 1998a).

No effect: The proposed action will not affect listed species or designated critical habitat.

May affect, but is not likely to adversely affect: Effects of the proposed action on listed species is expected to be discountable, insignificant, or completely beneficial.

- *Discountable effects* are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.
- *Insignificant effects* relate to the size of the impact and should never reach the level where incidental take may occur.
- *Beneficial effects* are contemporaneous positive effects without any adverse effects to the species. In the event that the overall effect of the proposed action is beneficial to the listed species, but also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species.

May affect, and is likely to adversely affect: Effects of the proposed action on listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial.

Candidate Species

Section 7 consultation under the Endangered Species Act does not apply to species that are candidates for listing, only species that are currently listed or are proposed for listing. However, one candidate species is included in this analysis. For candidate species, the following terms are used in documenting the level of anticipated effect:

No impact: The proposed action will not affect the candidate species or its habitat.

Beneficial impact: the proposed action will result in beneficial impacts to the candidate species or its habitat.

May impact individuals but is not likely to result in a trend toward federal listing: The proposed action has the potential to adversely impact individual members of the species or its habitat but would not contribute toward loss of population viability or measurably change the existing trends toward federal listing.

Is likely to result in a trend toward federal listing: The proposed action has the potential to adversely impact individual members of the species or its habitat and would likely contribute toward a loss of population viability and/or measurably change the existing trends toward federal listing.

Humpback Chub

Status and Background

The humpback chub was listed as endangered on March 11, 1967 (32 Federal Register [FR] 4001). It is a medium-sized freshwater fish of the minnow family, Cyprinidae. The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1955, Minckley et al. 1981). Humpback chub remains have been dated to about 4000 BC, but the fish was not described as a species until the 1940s (Miller 1946), presumably because of its restricted distribution in remote whitewater canyons (USFWS 1990). Because of this, its original distribution is not known.

The humpback chub is an obligate warm-water species that requires temperatures of about 16-22°C (61-72°F) for spawning, egg incubation, and optimal survival of young. Spawning is usually initiated at about 16°C (61°F) (Hamman 1982). Highest hatching success is at 19–20°C (66-68°F) with an incubation time of 3 days; and highest larval survival is slightly warmer at 21–22°C (70-72°F) (Marsh 1985).

Humpback chub attain a maximum size of about 480 mm TL (18.9 in) and 1.2 kg (2.6 lbs.) in weight (Valdez and Ryel 1997) and can live 20-30 years (Hendrickson 1993). Humpback chub grow relatively quickly at warm temperatures until maturity at about 4 years of age, at which time growth rate slows substantially. Humpback chub larvae are approximately 7 mm (0.30 in) long at hatching (Muth 1990). Clarkson and Childs (2000) found that lengths, weights, and specific growth rates of humpback chub were significantly lower at 10°C and 14°C (50-57°F; similar to hypolimnetic dam releases) than at 20°C (68°F; i.e. more characteristic of LCR temperatures during summer months).

Humpback chub are typically omnivores with a diet consisting of insects, crustaceans, plants, seeds, and occasionally small fish and reptiles (Kaeding and Zimmerman 1983, Kubly 1990, Valdez and Ryel 1995). They appear to be opportunistic feeders, capable of switching diet according to available food sources, and ingesting food items from the water's surface, midwater, and river bottom. Valdez and Ryel (1995) examined diets of humpback chub in GCNP. Guts of 158 adults from the mainstem Colorado River, flushed with a nonlethal stomach pump, had 14 invertebrate taxa and nine terrestrial taxa, including simuliids (blackflies, in 77.8% of fish), chironomids (midges, 57.6%), Gammarus (freshwater shrimp, 50.6%), Cladophora (green alga, 23.4%), Hymenoptera (wasps, 20.9%), and cladocerans (water fleas, 19.6%). Seeds and human food remains were found in eight (5.1%) and seven (4.4%) fish, respectively.

There are six populations of humpback chub in the Colorado River basin; five in the upper basin, and one in the lower basin (basins divided by GCD). The upper basin populations include three in the Colorado River: at Cataract Canyon, Utah; Black Rocks, Colorado; and Westwater Canyon, Utah; one in the Green River in Desolation and Grey Canyons, Utah; and one in the Yampa River in Dinosaur National Monument, Colorado. The lower basin population is found in the Colorado River and tributaries in GCNP.

GCNP Distribution and Population Status

The GCNP population is the largest remaining population in this species' range in the Colorado River basin, and the only population left in the Lower Basin below GCD. This population consists of nine aggregations (Table 3), with most individuals found in and near the LCR (Valdez and Ryel 1995), which is the largest tributary to the Colorado River in GCNP. The species spawns primarily in the lower 13 miles of the LCR, but occasional spawning is suspected in other areas of the Colorado River (Valdez and Masslich 1999, Anderson et al. 2010). Juveniles have been found in Fence Fault Warm Springs at RM 30 (Valdez and Masslich 1999) and further downstream in Middle Granite Gorge (RM 115 – RM 201) and beyond (NPS, unpublished data, 2009 backwater seining). Juvenile humpback chub occur downstream from GCD at most aggregations, but it is uncertain if these fish originated from the LCR or from local reproduction.

Mark-recapture methods have been used since the late 1980s to assess trends in adult abundance and recruitment of the LCR aggregation, the primary aggregation constituting the GCNP population. Current methods for assessment of the abundance and trend of this population of humpback chub rely on the ASMR model using data collected within the LCR (Coggins et al. 2006a, Coggins and Walters 2009). Although Coggins and Walters (2009) caution that the ASMR has limited capability to provide abundance estimates, the most important finding in their report is that the population trend in humpback chub has increased recently. Results of ASMR analyses indicate that the adult population declined through the 1980s and early 1990s but has been increasing for the past decade (Appendix A, Figure 8) (Coggins et al. 2006b, Coggins and Walters 2009). The most recent ASMR analysis indicates the GCNP population is between 9,000 – 12,000 humpback chub (S. Vanderkooi, personal communication, to B. Healy/NPS, September 28, 2012), however the most recent peer-reviewed, published analysis was completed including data through 2008 (6,000-10,000 adults, Walters and Coggins 2009).

Abundance estimates for aggregations of humpback chub in the mainstem outside of the LCR were conducted in the mid-1990s (see Table 3) (Valdez and Ryel 1995), however mark-recapture pilot studies were initiated at the Shinumo aggregation in 2012 to determine the feasibility of using baited hoop nets for estimating abundance of humpback chub within the mainstem aggregations (results pending). In addition, preliminary population estimates were generated for 2010 and 2012 using pooled capture probability data from the mainstem aggregations (Appendix A, Figure 9) (Persons and Van Haverbeke, 2012). Based on the most recent preliminary estimates, several of the aggregations have increased recently, as a result of translocations to Shinumo and Havasu Creeks, and possibly due to good production at the LCR and warmer than normal water temperatures in 2004, 2005, and 2011, as well as trout control implemented at the LCR inflow (Persons and Van Haverbeke 2012).

Table 3. Population estimates (adult humpback chub abundance. N where available, with 95% confidence intervals, and locations (river mile) of eight of the mainstem humpback chub aggregations in GCNP estimated by Valdez and Ryel (1995). NA=not available.

Aggregation	River Miles	N	95% CI
30-Mile	29.8–31.3	52	24-136
Little Colorado River Inflow*	57–65.4		Approx.. 9,000-12,000
Lava Chuar to Hance	65.7–76.3	NA	
Bright Angel Creek Inflow	83.8–92.2	NA	
Shinumo Creek Inflow	108.1–108.6	57	31-149
Stephen Aisle	114.9–120.1	NA	
Middle Granite Gorge	126.1–129.0	98	74-153
Havasu Creek Inflow	155.8–156.7	13	5-70
Pumpkin Spring	212.5–213.2	5	4-16

*LCR estimate for 2011, provided by USGS-GCMRC, S. Vanderkooi, personal communication, 9/28/2012.

Adult humpback chub occupy swift, deep, canyon reaches of river (Valdez and Clemmer 1982, Archer et al. 1985, Valdez and Ryel 1995), with microhabitat use varying among age-groups (Valdez 1990). Within GCNP, adults demonstrate high microsite fidelity and occupy main channel eddies, while subadults use nearshore habitats (Valdez and Ryel 1995, Robinson et al. 1998, Stone and Gorman 2006). Valdez and Ryel (1995, 1997) reported on adult humpback chub habitat use in the Colorado River in GCNP. They found adults used primarily large recirculating eddies, occupying areas of low velocity adjacent to high-velocity currents that deliver food items. Adults also congregated at tributary mouths and flooded side canyons during high flows. Young humpback chub use shoreline talus, vegetation, and backwaters typically formed by eddy return current channels (AZGFD 1996, Converse et al. 1998). These habitats are usually warmer than the main channel especially if they persist for a long time and are not inundated or desiccated by fluctuating flows (Stevens and Hoffnagle 1999). Subadults also use shallow, sheltered shoreline habitats but with greater depth and velocity (Valdez and Ryel 1995, Childs et al. 1998). Hoffnagle et al. (1999) reported that juveniles in GCNP used talus shorelines at all discharges and apparently were not displaced by a controlled high flow test of 45,000 cfs in late March and early April 1996. Valdez et al. (1999) also reported no displacement of radio-tagged adults, with local shifts in habitat use to remain in low-velocity polygons within large recirculating eddies.

As young humpback chub grow, they exhibit an ontogenic shift toward deeper and swifter offshore habitats that usually begins at age 1 (about 100 mm [3.94 in] TL) and ends with maturity at age 4 (≥200 mm [7.87 in] TL) (Valdez and Ryel 1995, 1997, Stone and Gorman 2006). Valdez and Ryel (1995, 1997) found that young humpback chub (21–74 mm [0.83-2.91 in] TL) remain along shallow shoreline habitats throughout their first summer, at low water velocities and depths less than 1 m (3.3 ft.). They shift as they grow larger (75–259 mm [2.95-10.20 in] TL), and by fall and winter move into deeper habitat with higher water velocities and depths up to 1.5 m (4.9 ft). Stone and Gorman (2006) found similar results in the LCR, finding that humpback chub undergo an ontogenesis from diurnally active, vulnerable, nearshore-reliant YOY (30–90 mm [1.81-3.54 in] TL) to nocturnally active, large-bodied adults (180 mm [7.09 in] TL), that primarily reside in deep mid-channel pools during the day, and move inshore at night. This ontogenetic habitat shift may be important for smaller streams to which humpback chub have been translocated. Spurgeon (2012) found that larger humpback chub translocated to Shinumo Creek were more likely to emigrate, and in addition, most movements were nocturnal.

Movement of adult humpback chub is substantially limited compared to other native Colorado River fishes (Valdez and Ryel 1995, Paukert et al. 2006). Adults have a high fidelity for site-specific habitats in the Colorado River and generally remain within a 1 km (0.6 mi) area, except during spawning ascents of the LCR in spring. Adult radio-tagged humpback chub demonstrated a consistent pattern of greater near-surface activity during the spawning season and at night, and day-night differences decreased during moderate to high turbidity. However, a juvenile humpback chub translocated to Shinumo Creek in June 2009, was detected at a remote PIT-tag antenna array within the LCR in May 2012, which means the fish swam approximately 47 miles upstream (W. Persons, personal communication to B. Healy/NPS, Nov. 26, 2012).

Humpback chub in GCNP spawn primarily during March–May in the lower 13 km (8 miles) of the LCR (Kaeding and Zimmerman 1983, Minckley 1996, Gorman and Stone 1999, Stone 1999) and during April–June in the upper basin (Kaeding et al. 1990, Valdez 1990, Karp and Tyus 1990). Evidence of reproduction has also been documented at a warm spring on the Colorado River upstream of the LCR at Fence Fault (RM 30) (Valdez and Masslich1999). Adults stage for spawning runs in large eddies near the confluence of the LCR in February and March and move into the tributary from March through May, depending on temperature, flow, and turbidity (Valdez and Ryel 1995). Ripe males have been seen aggregating in areas of complex habitat structure (boulders, travertine masses, and other sources of angular variation) associated with deposits of clean gravel, and it is thought that ripe females move to these aggregations to spawn (Gorman and Stone 1999). During monitoring of translocated humpback chub in Havasu Creek by NPS staff, ripe males were observed in May (Nelson et al. 2012a). Habitats where ripe humpback chub have been collected are typically deep, swift, and turbid. Likely as a result, spawning in the wild has not been directly observed. Abrasions on anal and lower caudal fins of males and females in the LCR and in Cataract Canyon (Valdez 1990) suggest that spawning involves rigorous contact with gravel substrates.

Threats

The decline of humpback chub throughout its range and continued threats to its existence are due to habitat modification and streamflow regulation (including cold-water dam releases and habitat loss), competition with and predation by non-native fish species, parasitism, hybridization with other native *Gila*, and pesticides and pollutants (USFWS 2002a). Streamflow regulation, in general, eliminates flows and temperatures needed for spawning and successful recruitment, which is exacerbated by predation and competition from non-native fishes. In GCNP, brown trout, channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout have been identified as principal predators of young humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997, Valdez and Ryel 1997). Yard et al (2011) estimated that rainbow and brown trout preferentially preyed upon native fish species, including humpback chub, over non-native species in the LCR inflow reach of the Colorado River, and that although the occurrence of humpback chub in rainbow trout stomachs was less frequent when compared to brown trout, at high abundance the rainbow trout population could consume as many or more native fish than brown trout. Valdez and Ryel (1997) also suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the LCR.

In the upper basin, channel catfish have been identified as the principal predator of humpback chub in Desolation/Gray Canyons (Chart and Lentsch 2000), and in Yampa Canyon (USFWS 2002a). Smallmouth bass (*Micropterus dolomieu*) have also become a significant predator recently in the Yampa River, and the species is likely the greatest threat to native fish compared to northern pike and channel catfish (Johnson et al. 2008). Smallmouth bass have been captured in small numbers within GCNP near the LCR inflow and downstream of Diamond Creek (USGS-GCMRC, unpublished data), and are common in Lake Powell and Lake Mead upstream and downstream of the project area. Under warmer river conditions, such as those observed during the early 2000s, related to low Lake Powell levels, smallmouth bass and other warm-water predators could become more of a threat to the native fish with GCNP.

Currently, the LCR is the primary spawning area for humpback chub and the LCR and its inflow support approximately 80-95% of the entire GCNP population of humpback chub. A chemical spill, increase in abundance of warm-water non-native predators, or parasite or disease outbreak within the LCR could have severe impacts on this population. The highway 89 bridge crossing the LCR at Cameron, Arizona, upstream of humpback chub spawning habitat, is commonly cited as the location of greatest risk for a hazardous materials spill (GCDAMP–Technical Work Group 2009).

Stress upon individual humpback chub related to sampling using netting and electro-fishing gears as well as handling by researchers is also a potential source of injury or mortality to individuals. For example, Hunt et al. (2012) demonstrated high stress and post-release mortality in hatchery-reared razorback sucker and bonytail related to trammel netting at higher water temperatures (25°C). Injuries and mortality in rainbow trout captured with electro-fishing equipment combined with high water temperatures in June has been observed at Shinumo Creek (B. Healy, personal observation), however salmonids are particularly sensitive to electro-fishing injury (Snyder 2003). No immediate mortality of humpback chub has been documented during tempering prior to release, hoop-netting, or electro-fishing during monitoring associated with NPS translocation projects in Shinumo and Havasu Creeks. Humpback chub were captured and handled 1,068 times between June 2010 and September 2012 in Shinumo and Havasu Creeks (NPS data). However, some minimal mortality has occurred during juvenile collection efforts at the LCR for translocations and refuge development, although it is generally less than 5% (R. Van Haverbeke, personal communication to B. Healy/NPS, Nov. 28, 2012). Five to ten fish out of 500-800 generally die during transport en route to hatchery rearing facilities and during parasite and disease treatments, however approximately 60 (10%) were lost at a hatchery facility during disease treatments and tagging prior to translocations in 2011.

Sampling outside of tributaries by the NPS fisheries program has been minimal, however 56 baited hoop nets were set over three days in the Shinumo inflow during September 2012, as part of a combined effort with the USGS-GCMRC and USFWS to sample GCNP humpback chub aggregations (Nelson et al. 2012b). Fifty-two humpback chub were captured, and no mortalities were observed.

An extensive fisheries monitoring and research program is being implemented by the GCDAMP through the USGS-GCRMC throughout the project area. Incidental mortality was reported to the USFWS by the USGS-GCMRC biology program manager (S. Vanderkooi) and summarized here. In 2012, 22 incidental mortalities out of 7,755 total humpback chub captures (0.28%) were associated with fish monitoring in the Colorado River using a variety of gear types. Another four humpback chub were lost out of 725 captures in the lower sections of the LCR (0.55%). The highest mortality rate was associated with experimental collections and rearing of larval humpback chub to be used in translocations (close to 30% of fish captured). Mortality data for the LCR humpback chub monitoring program conducted by the USFWS are not included in these numbers.

Analysis and Determination of Effects

Several activities in the CFMP involve implementation of conservation measures for humpback chub that were listed in the most recent BO for the operation of GCD including humpback chub translocations and associated non-native fish control, Bright Angel Creek brown trout control, and actions to conserve and monitor mainstem humpback chub aggregations (USFWS 2011a). Nevertheless, aspects of these conservation measures and other actions designed to benefit native species, including humpback chub, may have the potential to cause injury or mortality to individuals in both the mainstem and GCNP tributaries. The analysis focuses on actions to conserve and recover humpback chub as well as those actions that may harm individuals.

As discussed above (see Threats), there are risks associated with CFMP activities related to handling stress and mortality caused directly by fish sampling equipment and handling by researchers (e.g., measuring, tagging). However, the risk of mortality is likely low. Non-native fish mechanical removal programs (i.e., netting, electro-fishing, angling, snorkeling/spearing, etc.), which may impact individual humpback chub, will occur associated with non-native fish emergency control actions, mechanical removal in or near tributaries in conjunction with translocations, comprehensive brown trout control, and targeted angling trips focused on rainbow trout removal in Marble Canyon. Monitoring of humpback chub associated with translocation projects, as well as collection of juvenile humpback chub from the LCR also has the potential to harm or cause mortality of individuals.

During previous years, 32 to 38 fisheries monitoring or research trips were conducted by state and federal agencies (Appendix C). Under the CFMP, an estimated seven additional fisheries monitoring trips would be conducted in a typical year, with the majority of the additional sampling effort being focused on areas of the Colorado River downstream of Lava Falls (RM 179.2) to the Lake Mead inflow. The objective of these additional trips is to gather additional inventory and sonic-telemetry data to assess the status of razorback sucker, as well as inventory non-native species. Other trips launched for the purpose of removing non-native trout, comprised of volunteer anglers, would occur in Marble Canyon (between the Paria River and the LCR).

A review of past capture and handling data help inform the assessment of risk for injury to humpback chub for the projects included in the CFMP. No immediate mortality of translocated fish was observed in Shinumo and Havasu Creeks after capturing and handling over 1,000 humpback chub since 2010, including fish handled on multiple occasions (NPS, unpublished data). Fish were mainly captured in hoop nets, minnow traps, and seining, with a small number captured with angling and electro-fishing equipment. Mainstem aggregation monitoring for humpback chub has been conducted using both hoop and trammel nets. As discussed above, a higher level of risk to humpback chub may be expected from trammel netting, and immediate mortality has been observed (B. Healy, personal observation), but steps would be taken to minimize the risk (see Conservation Measures), and most monitoring associated with translocations would utilize other gear types. In contrast, delayed mortality cannot be observed in the field during monitoring efforts because fish are released immediately, and thus, delayed mortality may have occurred and gone unnoticed following the fishes' release.

The frequency of incidence of delayed mortality could be quantified in humpback chub captured using hoop nets and seining and then held in a hatchery facility for refuge development or for future translocations. For example, out of approximately 500 collected, nine juvenile (YOY or age-1) humpback chub were lost during capture efforts in the LCR and transport from the LCR to the USFWS Dexter National Fish Hatchery in July and October 2009. No mortality occurred during October 2009 capture efforts in the LCR. Mortality that occurred at the hatchery and during transport is included in this total for 2009 as well. The highest delayed mortality observed since 2009 (about 10%, discussed above) related to these efforts occurred following collection efforts in the fall of 2010 and winter 2011, prior translocations, but most mortality was related to hatchery treatments following disease introduction from other wild fish brought on station. Collection efforts would likely represent higher stress upon captured fish than standard field monitoring because the fish are captured in nets, transported in buckets to holding wells in the river for up to 3-4 days, transferred to coolers, flown out of the LCR in a helicopter, transferred from a cooler to a hatchery truck, driven several hours to a hatchery, and then subjected to parasite and disease treatments. Thus, it is expected that less than 10% mortality upon humpback chub would occur due to netting efforts.

Electro-fishing would be used widely for non-native fish control within GCNP, including and in conjunction with humpback chub translocation projects, and possibly in GCNRA if an emergency action was necessary to remove newly introduced non-native fish or those that increase in abundance. Although these efforts would benefit humpback chub by reducing non-native predators and competitors, mechanical removal using pulsed DC electro-fishing may result in some injury to humpback chub through spinal hemorrhaging, or even mortality, but no effects on growth or survival were detected in laboratory tests using bonytail as surrogates (Ruppert and Muth 1997). Cowdell and Valdez (1994) studied electrofishing effects in the field on a related species, roundtail chub, and found that 5% of fish (2 out of 40) sampled were injured using similar gear settings to those used at Shinumo Creek (40-Hz pulsed DC). The effects of electro-fishing upon fish were extensively reviewed by Snyder (2003). In conclusion, Snyder (2003) concluded that except in extreme cases, injuries due to electro-fishing heal and result in minimal delayed mortality, and that even in salmonids, which are particularly sensitive to injury by electro-fishing, population-level effects would be unlikely.

Results of simulations using a population viability model developed by Pine et al. (*in press)* suggested that humpback chub populations are resilient to losses that may be incurred due to collections for translocations or scientific activities (i.e. handling or gear-related mortality or targeted collections) at current levels. From 500 to several thousand juvenile humpback chub between 30 and 130 mm TL may be collected from the LCR to support translocation efforts described in the CRMP. The smallest size classes would be targeted for translocation collections (30-60 mm TL or smaller), since the survival of smaller fish would be expected to be lower. No extinction risk and a percent change in abundance of between 4.4% and 13.2% was found when between 10% and 50% of large juveniles (80-130 mm TL), respectively, were removed from the population under a conservative set of parameters, such as low recruitment compensation (Pine et al. *in press*). Recruitment compensation represents the extent to which juvenile survival increases at lower abundance relative to juvenile survival at stable, unexploited levels. Under less conservative recruitment compensation parameters, which may be more appropriate given weaker correlations between mark-recapture estimates for age-1 and age-2 juveniles in the LCR cited in Pine et al. (*in press*) that indicate stronger recruitment compensation, declines in abundance were less than 2% and would likely not be measurable at the population scale. In addition to between 50 and 200 (up to 1000) humpback chub that are estimated to be lost due to handling stress and collections for scientific purposes (P. Sponholtz, USFWS, personal communication, as cited in USFWS 2011a), between 500 and 800 juvenile humpback chub have been collected annually from the LCR since 2008 for translocations and refuge development. Despite removal of these young fish from the population, the GCNP humpback chub population has not declined, but instead, appears to be on a continuing upward trend (see Background above), indicating the level of handling and removals for translocations and other purposes has little impact on the population as a whole under the conditions observed over the past several years,

Recommendations provided by Snyder (2003), as well as other measures to minimize the risk of potentially harmful effects of electro-fishing will be followed for electro-fishing operations related to the CFMP. Conservation Measures, along with fish handling procedures developed by USGS-GCMRC (Persons and Ward 2013) are listed below. While occasionally humpback chub may be captured by anglers during Marble Canyon volunteer trout control trips, or by biologists in tributaries, areas with concentrations of rainbow trout, and few humpback chub would be targeted. No barbed hooks or bait would be used by anglers in tributaries or near humpback chub aggregations, so injury potential is likely low (see Conservation Measures). Population viability models (e.g. Pine et al. *in press*) will continue to be used to assist managers in predicting the impact of collections of fish for translocations on the population, and models will be updated as new information is gathered through ongoing monitoring and research associated with the

GCDAMP. The application of these measures, as well as continued monitoring incorporated into the adaptive management framework for the implementation of translocations and non-native fish control, will further minimize the risk of injury and mortality to individuals and potential population-scale effects.

Despite the potential for injury to individual humpback chub described above, the CFMP activities were designed to achieve NPS conservation goals, desired conditions, and objectives for native fish communities and contribute towards the recovery of humpback chub over the long-term (20 years or more). CFMP goals and objectives for humpback chub emphasize restoring a broader distribution of humpback chub throughout GCNP by augmenting or expanding existing aggregations, while reducing the potential for predation by and competition with non-native species.

Humpback chub translocations to Havasu and Shinumo Creeks would be the focus of initial translocation efforts, following genetic management principles, described above, to minimize the potential for the loss of genetic integrity. Depending on the results of trout control efforts at Bright Angel Creek, following a 5-year evaluation, humpback chub may also be translocated there as well. Ideally, depending on the availability of fish and hatchery space, 200 additional humpback chub would be translocated to both Shinumo and Havasu Creeks for a minimum of 5 years, and up to 10 years, followed by population and genetic monitoring and augmentation (additional translocations), if necessary. These tributaries were thought to be the highest priorities for translocations (Valdez et al. 2000; GCWC and SWCA 2006). Other tributaries would continue to be assessed, and in the future, following interagency discussions, may be considered for translocations. Translocations of humpback chub may eventually contribute towards the establishment of a second spawning population of the species in GCNP (outcome 1), however, whether humpback chub will spawn in a tributary outside of the LCR or in a mainstem area is a key uncertainty that will be determined through additional monitoring. It is likely that translocations would, at the least, provide rearing opportunities for juvenile humpback chub and continue to contribute toward augmentation of mainstem aggregations (outcome 2), as described in sections above. For example, more than 80% of the humpback chub captured in the Shinumo inflow aggregation during September 2012 were fish that had been translocated to Shinumo Creek between 2009 and 2011 (GCMRC/USFWS/NPS, unpublished data).

The most recent annual apparent survival estimates of translocated humpback chub were 0.41 (0.30 – 0.51, 95% CI) and 0.49 (0.41 – 0.56) for fish residing in Shinumo and Havasu Creeks, respectively, which are similar to apparent survival rates found for juvenile humpback chub in the LCR inflow area (Finch 2012, Near Shore Ecology Study), despite high emigration rates found for Shinumo Creek humpback chub (Spurgeon 2012). However, the most recent PIT tag antenna data have not been analyzed to determine emigration rates after 2011. These results indicate that true survival rates, as opposed to apparent survival estimates that include mortality plus emigration rates, are likely high, since many of the fish that leave the tributaries, are later captured alive in the mainstem. Revised and expanded monitoring in the mainstem may allow for improved survival estimates that incorporate emigration rates.

Expanded annual electro-fishing into the lower sections of Shinumo Creek, which would occur no more than once per year, will allow for improved monitoring of rainbow trout population trends and an assessment of trout removal efficiency that was not possible during previous years. Snorkeling to determine rainbow trout abundance was attempted, but is thought to be infeasible and inaccurate (Healy et al. 2011). Trout removal using angling equipment would also be conducted on monitoring trips when electro-fishing gear would not be used (June). As discussed above, survival of humpback chub doubled from previous years when trout abundance was at its lowest level, however direct correlations between the abundance of rainbow trout and humpback chub could not be measured because trout control and population estimates were conducted for upstream areas of the translocation reaches. Nevertheless, the upstream trout abundance and size structure data may be considered indicative of the rainbow trout population within the lower reaches of Shinumo Creek, since angling in lower reaches produced only small numbers of small fish in 2012 (B. Healy, personal observation, NPS unpublished data), similar to the results found using electro-fishing gear upstream. Combined with food web data for Shinumo Creek that suggested dietary overlap between humpback chub and rainbow trout (Spurgeon 2012), the evidence suggests that removal of trout may lead to increased growth and survival of humpback chub. Improved monitoring that will be conducted in the mainstem, in coordination with GCMRC/USFWS, along with continued operation of the remote PIT tag antenna, will allow for improved survival and emigration estimates as well.

Comprehensive mechanical removal of brown and rainbow trout in the Bright Angel Creek and Inflow FMZ using tributary electro-fishing, boat-based electro-fishing in the inflow, and weir installation and operation during the fall/winter months may benefit the humpback chub population in several ways. Low survival of juvenile humpback chub likely led to past declining trends in adult humpback chub (Coggins et al. 2006b), and brown and rainbow trout predation is thought to be an important source of mortality for juvenile humpback chub, particularly when trout are in high abundance (Yard et al. 2011, USFWS 2011b) and water temperatures are cold. At warm water temperatures, other species may constitute a greater threat (e.g., smallmouth bass). By removing brown trout at their source, it is thought that emigration to the LCR inflow, and thus predation, may be minimized (USFWS 2011b). Dispersal of humpback chub juveniles from the LCR to downstream aggregations and mixing of adults between aggregations may also be enhanced by reducing the number of trout in the Bright Angel FMZ. Data suggest that Bright Angel Creek is an important source of brown trout for GCNP, and therefore the most intensive brown trout control efforts would be focused in Bright Angel Creek and between Zoroaster and Horn Creek rapids. The Bright Angel Creek and Inflow FMZ continue to contain the highest concentration of brown trout in GCNP (Valdez and Ryel 1995, Makinster, et al. 2010, Bunch et al. 2012, Omana-Smith et al. 2012), and spawning adult brown and rainbow trout and YOY have been documented in the creek (Omana-Smith et al.2012). Adult brown trout in spawning condition tagged in the mainstem from as far away as RM 175 downstream (Sponholtz et al. 2010), and RM 53.9 upstream (Leibfried et al. 2004), were captured in the weir in Bright Angel Creek. Boat electro-fishing in the inflow of Bright Angel Creek would be implemented during the time that would likely be the most effective; when trout are aggregating in the reach prior to spawning migrations into the creek, when turbidity would be less likely to inhibit capture efficiency (GCMRC turbidity data, summarized by C. Nelson, NPS), and when the fish from the previous years' cohort will have grown to a size that would have a greater likelihood of capture using electro-fishing prior to spawning (smaller fish are less likely to be captured relative to large fish) (Saunders et al. 2011, Healy et al. 2013).

Brown trout, and other highly piscivorous species (Ictalurids/catfish, striped bass, smallmouth bass, etc.) incidentally captured from anywhere in the project area during monitoring efforts would also be removed under the CFMP. Although the extent to which this action may contribute towards a population-scale decline of brown trout or other species is unknown, the otoliths from these fish would be retained, and otolith microchemistry analysis (see Hayden et al. 2012) could be performed identifying the natal origin of these fish (if funding is available). Identifying other sources, beyond Bright Angel Creek, of these predators may help focus future control efforts.

The razorback sucker status surveys included in the first phase of the feasibility study included within the CFMP, includes a larval fish study to determine presence/absence and whether razorback sucker spawning may be occurring in the Lower Colorado River FMZ. Over the three year duration of the study, these activities may result in the death of individual larval humpback chub, if spawning is occurring in this area. Lethal sampling is required since larval fish identification must be performed in a laboratory setting. However, if larval humpback chub are collected, analysis can be conducted to determine the individual's natal origin, which would help inform future management of the species in GCNP. This study has been incorporated into an ESA Section 10 (Recovery) Permit to be held by a contractor. If the earlier phases of the razorback sucker management/augmentation studies suggest that stocking of razorback sucker in the Lower Colorado FMZ is a feasible option, additional ESA section 7 consultation on the effects to humpback chub may be required. The release of 10-20 sonic-tagged adult razorback sucker in this area, associated with Phase I (described above), would have no impact to humpback chub.

Triploid (sterile) rainbow trout would be experimentally released into the Glen Canyon Reach of GCNRA to maintain a sport fishery there in the event that rainbow trout abundance severely declines due to whirling disease, conditions caused by dam operations, or some other unforeseen factor. While non-native species such as rainbow trout prey upon and compete with humpback chub, it is unlikely that a negative impact to humpback chub would be expected by this action, since the fish would be unable to reproduce and stocking would occur only when extremely low levels of rainbow trout abundance occur in the Glen Canyon Reach FMZ. Rainbow trout abundance would be much lower than abundance indicated by data collected recently before stocking would occur. For example, in a review of data collected by AZGFD between 1991 and 2011, the triggers would have never been reached to initiate triploid trout stocking. In addition, survival of catchable-sized hatchery-reared and stocked triploid trout has been shown to be relatively low (1-2% annual survival of hatchery raised trout, reviewed in High and Meyer 2009), and thus, stocked fish would likely persist for only short periods of time, decreasing the likelihood of interactions with native fish 50 or more miles downstream at the LCR inflow.

Dispersal of hatchery-reared and stocked trout has been found to be relatively low (High and Meyer 2009), and thus stocked trout would likely remain in close proximity to their release point. Nevertheless, to help ensure potential interactions are minimized between stocked triploid trout and native fish in GCNP, each individual fish released would be marked in some way so that ongoing monitoring programs can detect movements and performance of triploid trout. Thus, if monitoring indicated stocked triploid rainbow trout were moving downstream into Marble Canyon or were found at the LCR inflow, potentially threatening humpback chub, stocking could be adjusted or discontinued. In addition, if humpback chub and trout population triggers are met at the LCR inflow, as described in the USBR's non-native fish control EA (USBR 2012), trout removal would be implemented in the LCR inflow reach.

Cumulative Effects

Cumulative effects include the effects of future state, local, private or tribal management actions that may occur in the project area during the duration of the plan (20 years). Future federal actions, that have not been previously approved, are not included in this section because additional ESA section 7 consultation would be required. These include the GCDAMP's Long-term Experimental and Management Plan. These actions are discussed in the current condition section, earlier in the document.

A local development project proposed in the town of Tusayan, Arizona, may threaten humpback chub habitat by withdrawing water from the same aquifer that is the basis for streamflow in Havasu Creek, however the true extent of water withdrawals and their effects on Havasu Creek baseflow are unknown. In future years, the adaptive management framework for humpback chub translocations to Havasu Creek will allow for changes in management strategies in the case that streamflows are reduced to a point that the project is not viable, which is unlikely.

The Navajo Tribal Government has proposed a development on the banks of the LCR, called the "Escalade," near the confluence with the Colorado River which may impact humpback chub habitat. Only conceptual plans have been released by the developer, and thus, it is unclear to what extent humpback chub and their habitat will be impacted. Riparian vegetation may be impacted by the footprint of the development, and the project will increase accessibility to the area by visitors, which would also impact vegetation. Nevertheless, the actions in the CFMP were developed to improve the status of humpback chub, and would not add to the potential negative effects of the Navajo development.

Summary

With associated monitoring and adaptive management, actions included in the CFMP would achieve beneficial impacts, at a population level to humpback chub. Initial activities and monitoring results suggest that translocations would benefit humpback chub by achieving a wider distribution and higher abundance of humpback chub in downstream aggregations, and could lead to a second spawning aggregation in GCNP. Comprehensive control of brown and rainbow trout around Bright Angel Creek may result in reduced competition with or predation upon humpback chub in the mainstem (as well as in Shinumo Creek), and emergency non-native fish control actions would allow managers to react quickly to emerging threats in the future. Responding to increases in abundance or new introductions of warm-water non-native species may become particularly important in the future with potentially upper basin drought conditions, low Lake Powell Reservoir water levels, and consequently, warmer GCD discharge.

While overall, the proposed action would have beneficial impacts to humpback chub, some elements of the CFMP have the potential to directly impact humpback chub through disturbance, injury, and mortality. Therefore, NPS has determined the proposed action ***may affect, and is***

likely to adversely affect individuals, but will not likely have adverse impacts at population levels.

Critical Habitat and Determination of Effects

Critical habitat for humpback chub was designated in 1994. Seven reaches of the Colorado River system were designated as critical habitat for humpback chub for a total river length of 379 miles in the Yampa, Green, Colorado, and Little Colorado River, in Arizona, Colorado, and Utah. Primary constituent elements include water, physical habitat, and biological environment as required for each life stage (59 FR 13374; USFWS 1994). Water includes a quantity of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, and turbidity) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage. Physical habitat includes areas used for spawning, nursery, feeding, and rearing, or corridors to these areas. The biological environment includes food supply and habitats with levels of non-native predators and competitors that are low enough to allow for spawning, feeding, and rearing.

Within GCNP, the Colorado River from RM 34 to RM 208 has been designated as critical habitat for the humpback chub as well as the lower eight miles of the LCR. The quality and quantity of the Colorado River through GCNP is controlled by the operations of GCD and habitat conditions can change drastically due to those operations. NPS has determined that the proposed actions of this plan will have ***no effect*** on the critical habitat of the humpback chub within GCNP.

Conservation Measures

Electro-fishing:

- Electro-fishing gear will be set to avoid injury to native fish.
- In tributaries where humpback chub have been released, electro-fishing equipment will be minimized in large-volume, deep pools where gear is less effective in capturing fish, and where humpback chub tend to congregate.
- Block nets will be used during multiple-pass depletion electro-fishing where native fish are present to minimize applying electrical current to individual fish multiple times. Fish will be released downstream of block nets and outside the sampling area between passes.
- The least-intensive electro-fishing settings that effectively sample fish will be used in all cases. For example, during tributary electro-fishing in Grand Canyon, a pulsed-DC at a frequency of 30-40 Hz (300-350 volts) has proven to be sufficient.
- Fish captured using electro-fishing will be monitored in buckets, and gear settings would be adjusted if sufficient recovery is not observed.
- Crew members will be sufficiently trained in electro-fishing techniques.
- Netters and electrodes will be positioned so that fish can be removed from electrical fields as quickly as possible.

General Fish Handling:

- Trammel net use will be minimized when possible, and will not be used if water temperatures exceed 20°C. Trammel nets would be checked every 2 hours or less.

- The feasibility of the use of experimental mobile PIT tag antenna probes, where no handling of fish is necessary, will be determined, and considered for future sampling in lieu of handling PIT tagged humpback chub.
- During sampling efforts, all native fish will be processed first and handling time on captured humpback chub will be minimized whenever possible
- If incidental mortality occurs, humpback chub otoliths will be extracted and preserved (if feasible) and preserved in 100% ethanol, otherwise the entire fish will be preserved as above and deposited into GCNP's museum.
- "General Guidelines for Handling Fish" published by the USGS-GCMRC to minimize injury to fish would be followed during all field projects (see Persons et al 2013).
- No bait, or an artificial or natural substance that attracts fish by scent and/or flavor (i.e., live or dead minnows/small fish, fish eggs, roe, or human food), would be used by anglers participating in non-native fish control efforts. Barbless hooks would be used for trout removal activities.

Aquatic Nuisance Species

- Standard quarantine/hatchery pathogen and disease testing and treatment procedures will be followed to prevent the transfer of ANS from one water to another during humpback chub (or other native fish) translocations.
- To prevent inadvertent movement of disease or parasitic organisms among fish sites, research and management activities shall conform to the Declining Amphibians Population Task Force Field work Code of Practice (www.nrri.umn.edu/NPSProtocol/pdfs/Amphibians/Appendix%20B.pdf), with the exception that 10% bleach solution or 1% quarternary ammonia should be used to clean equipment rather than 70% ethanol. Abiding by this code will effectively limit the potential spread of pathogens via fish sampling equipment.

Interagency Coordination:

- All sampling activities will be coordinated with AZGFD (according to 43 CFR part 24) and the USFWS Arizona Fish and Wildlife Conservation Office, as well as the USGS-GCMRC or other agencies performing fish monitoring or research within the project-area.
- Annual reports documenting CFMP implementation and monitoring conducted by the NPS will be provided to USFWS, AZGFD, BOR, USGS and other interested parties.
- Monthly, or at least bimonthly, conference calls (or written status updates in lieu of a call) will continue to be held by the NPS Fisheries Program to update interested parties on ongoing or new NPS fisheries management activities.

Razorback Sucker

Status and Background

The razorback sucker was first proposed for listing under the ESA on April 24, 1978, as a threatened species. The proposed rule was withdrawn on May 27, 1980, due to changes to the listing process included in the 1978 amendments to the ESA. In March 1989, the USFWS was petitioned by a consortium of environmental groups to list the razorback sucker as an endangered species. A positive finding on the petition was published in the Federal Register on August 15, 1989. The finding stated that a status review was in progress and provided for submission of additional information through December 15, 1989. The proposed rule to list the species as endangered was published on May 22, 1990, and the final rule published on October 23, 1991, with an effective date of November 22, 1991. The Razorback Sucker Recovery Plan was released in 1998 (USFWS 1998b), and Recovery Goals were approved in 2002 (USFWS 2002b).

The razorback sucker is the only representative of the genus *Xyrauchen* and was described from specimens taken from the "Colorado and New Rivers" (Abbott 1861) and Gila River (Kirsch 1889) in Arizona. This native sucker is distinguished from all others by the sharp-edged, bony keel that rises abruptly behind the head. The body is robust with a short and deep caudal peduncle (Bestgen 1990). The razorback sucker may reach lengths of 1m (3.3 ft.) and weigh 5.0 to 5.9 kg (11 to 13 lbs) (Minckley 1973).

The razorback sucker is adapted to widely fluctuating physical environments characteristic of rivers in the pre-Euro-American settlement Colorado River Basin (USFWS 2002b). Razorback suckers are long-lived (45-50 years) and, once reaching maturity between two and seven years of age (Minckley 1983); apparently produce viable gametes even when quite old. The ability of razorback suckers to spawn in a variety of habitats, flows, and over a long season are also survival adaptations (USFWS 2002b). In the event of several consecutive years with little or no recruitment, the demographics of the population might shift, but future reproduction would not be compromised. Average fecundity recorded in studies ranges from 46,740-100,800 eggs per female (Bestgen 1990). With a varying age of maturity and the fecundity of the species, it would be possible to quickly repopulate an area after a catastrophic loss of adults.

Spawning takes place in the late winter to early summer depending upon local water temperatures. Various studies have presented a range of water temperatures at which spawning occurs. In general, temperatures from 10° to 20° C (50° to 68° F) are appropriate (Bestgen 1990). Adults typically spawn over cobble substrates near shore in water 0.9 to 3.0 m (3-10 ft) deep (Minckley et al. 1991). There is an increased use of higher velocity waters in the spring, although this is countered by the movements into the warmer, shallow backwaters and inundated bottomlands in early summer (McAda and Wydoski 1980, Tyus and Karp 1989, Osmundson and Kaeding 1989). Spawning habitat is most commonly over mixed cobble and gravel bars on or adjacent to riffles (Minckley et al. 1991).

Razorback sucker diet varies depending on life stage, habitat, and food availability (USFWS 2002b). Larvae feed mostly on phytoplankton and small zooplankton and, in riverine environments, on midge larvae. Diet of adults taken from riverine habitats consisted chiefly of immature mayflies, caddisflies, and midges, along with algae, detritus, and inorganic material (USFWS 1998b).

Adult razorback suckers use most riverine habitats, although there may be an avoidance of whitewater type habitats. Main channel habitats used tend to be low velocity ones such as pools, eddies, nearshore runs, and channels associated with sand or gravel bars (Bestgen 1990). Areas adjacent to the main channel, such as, backwaters, oxbows, sloughs, and flooded bottomlands are also used by this species (USFWS 2002b). From studies conducted in the upper Colorado River basin, habitat selection by adult razorback suckers changes seasonally. They move into pools and slow eddies from November through April, runs and pools from July through October, runs and backwaters during May, and backwaters, eddies, and flooded gravel pits during June. In early spring, adults move into flooded bottomlands (USFWS 2002b). They use relatively shallow water (3 feet [0.9 m]) during spring and deeper water (five to six feet [1.5-1.8 m]) during winter (USFWS 2002b).

Razorback suckers also use reservoir habitat, where the adults may survive for many years. In reservoirs, they use all habitat types, but prefer backwaters and the main impoundment (USFWS 1998a). Much of the information on spawning behavior and habitat comes from fishes in reservoirs where observations can readily be made. Habitat needs of larval and juvenile razorback sucker are reasonably well known. In reservoirs, larvae are found in shallow backwater coves or inlets (USFWS 1998b). In riverine habitats, captures have occurred in backwaters, creek mouths, and wetlands. These environments provide quiet, warm water where there is a potential for increased food availability (USFWS 2002b). During higher flows, flooded bottomland and tributary mouths may provide these types of habitats.

Razorback suckers are somewhat sedentary; however, considerable movement over a year has been noted in several studies (USFWS 1998b). During the spring spawning season, razorbacks may travel long distances in both lacustrine and riverine environments, and exhibit some fidelity to specific spawning areas (USFWS 1998b). In the Verde River, radio-tagged and stocked razorback suckers tend to move downstream after release. Larger fish did not move as much from the stocking site as did smaller fish (Clarkson et al. 1993).

Recovery for the razorback sucker is currently defined by the USFWS Razorback Sucker Recovery Goals (USFWS 2002b). The Recovery Goals define recovery as specific demographic criteria that must be attained, and recovery factors that must be met to achieve downlisting and delisting of razorback sucker. The recovery factors were derived from the five listing threat factors under ESA section 4(a), and state the conditions under which threats are minimized or removed sufficient to achieve recovery; a list of site-specific management actions and tasks (e.g. the development and implementation of non-native fish control programs) is also provided. They include the need to identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes to benefit razorback sucker for all the rivers in which the species occurs. Essentially, the goals identify actions needed to maintain the habitat features (i.e. the physical and biological features of critical habitat) to accomplish recovery. But the measures of whether or not actions are working with regard to recovery, and the basis for altering management actions through adaptive management, are the demographic criteria.

Population demographics in both recovery units must be met in order to achieve downlisting. The Recovery Goal demographic criteria for downlisting (there are no delisting criteria) are as follows (USFWS 2002b):

<u>Upper Basin Recovery Unit</u>

Green River Sub-basin

1. A self-sustaining population is maintained over a 5-year period, starting with the first point estimate acceptable to the USFWS, such that:

    a. the trend in adult (age 4+; ≥ 400 mm [15.7 inches] TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (300-400 mm [11.8-15.7 inches]TL) naturally produced fish equals or exceeds adult mortality, and

    c. each population point estimate exceeds 5,800 adults (Note: 5,800 is the estimated minimum viable population [MVP] number).

Upper Colorado River and San Juan River Sub-basins

1. A self-sustaining population is maintained in EITHER the upper Colorado River sub-basin or the San Juan River sub-basin over a 5-year period, starting with the first point estimate acceptable to USFWS, such that for either population:

    a. the trend in adult (age 4+; ≥ 400 mm [15.7 inches] TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (300-400 mm [11.8-15.7 inches]TL) naturally produced fish equals or exceeds adult mortality, and

    c. each point estimate exceeds 5,800 adults (MVP).

<u>Lower Basin Recovery Unit</u>

Lake Mohave

1. Genetic variability of razorback sucker in Lake Mohave is identified, and a genetic refuge is maintained over a 5-year period.

Remainder of Basin

1. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimate acceptable to USFWS, such that for each population:

    a. the trend in adult (age 4+; ≥ 400 mm [15.7 inches] TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (300-400 mm [11.8-15.7 inches] TL) naturally produced fish equals or exceeds adult mortality, and

c. each point estimate exceeds 5,800 adults (MVP).

GCNP Distribution and Population Status

The razorback sucker was once abundant in the Colorado River and its major tributaries throughout the lower basin, occupying 3,500 miles (5,633 km) of river in the United States and Mexico (Maddux et al. 1993). Records from the late 1800s and early 1900s indicated the species was abundant in the lower Colorado and Gila River drainages (Kirsch 1889, Gilbert and Scofield 1898, Minckley 1983, Bestgen 1990). It now occurs in portions of the upper Colorado, Duchesne, Green, Gunnison, White, and Yampa Rivers in the Upper Basin; and in the lower Colorado River from GCNP down to Imperial Dam.

Populations in the upper Colorado River Basin are being maintained through stocking (Nesler et al. 2003, Zelasko et al. 2010) and the lower basin populations are maintained through stocking and grow-out programs managed by the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). In the San Juan River there is evidence of spawning and recruitment primarily at the inflow area to Lake Powell (D. Elverud, Utah Division of Wildlife, personal communication). The only known reproducing and recruiting populations in the Colorado River Basin are in Lake Mead (primarily near inflow areas from the Colorado, Virgin, and Muddy Rivers) and the Las Vegas Wash (Albrecht et al. 2008, Kegerries and Albrecht 2011).

There is new information on recruitment to the wild razorback sucker population in Lake Mead (Albrecht et al. 2008, Kegerries and Albrecht 2011) that indicates some degree of successful recruitment is occurring at three locations in Lake Mead, and another spawning group was documented in 2010 at the Colorado River inflow area of the lake. This degree of recruitment has not been documented elsewhere in the species' remaining populations. As part of their ongoing commitment to conservation for this species, the AZGFD is an active participant in implementation of the razorback sucker recovery plan. In the Lower Colorado River Basin, efforts to reintroduce the species to the Gila, Salt, and Verde rivers have not been successful in establishing self-sustaining populations. Reintroduction efforts continue in the Verde River. Very few razorback suckers were recaptured from these efforts (Jahrke and Clark 1999). Stocking and other recovery efforts by the Upper Colorado River Basin and San Juan River Recovery Implementation Programs are ongoing. The LCRMSCP is also implementing conservation actions for the species.

Prior to 2012, only ten records of razorback sucker were known for GCNP (Valdez et al. 2012a), and razorback sucker were considered extirpated from GCNP. Individuals were captured from the mouth of the Paria River (1963, 1978), in the Colorado River near Bass Camp (RM 108, 1984), and in the LCR inflow (1989, 1990), as well as from Bright Angel Creek (1944) (Valdez et al. 2012a). In addition, either larval razorback sucker or hybrid razorback x flannelmouth sucker larvae were collected from Havasu Creek and LCR inflows in the 1990s (Douglas and Douglas 2000). Whether GCNP historically supported large populations of razorback sucker is unclear due to a lack of pre-dam quantitative fisheries surveys. Nevertheless, extensive fisheries surveys that occurred between the 1970s and 2006 did not result in any razorback sucker captures in the Lower Colorado River FMZ (Valdez et al. 2012a). However, in April 2012, five razorback sucker sonic-tagged in Lake Mead were detected within GCNP near Quartermaster

Canyon (RM 260) (Kegerries and Albrecht 2012). These fish were all between 460 and 565 millimeters, and were tagged in different areas of Lake Mead in 2010 and 2011. An additional untagged razorback sucker was captured in GCNP on October 7, 2012 during an AZGFD/USGS-GCMRC electro-fishing trip near Spencer Creek (RM 246) (A. Bunch, October 7, personal communication, AZGFD). Therefore, as of 2012 razorback sucker are not considered extirpated, however the extent to which razorback sucker are distributed in GCNP and their population dynamics are largely unknown.

Threats

The range and abundance of razorback sucker has been severely impacted by water manipulations, habitat degradation, and importation and invasion of non-native species. The construction of dams and reservoirs has destroyed, altered, and fragmented habitats needed by the sucker. Channel modifications have reduced habitat diversity, and degradation of riparian and upland areas has altered stream morphology and hydrology. Finally, invasion of these degraded habitats by a host of non-native predacious and competitive species has created a hostile environment for razorback sucker larvae and juveniles. Although the suckers produce large spawns each year and produce viable young, the larvae are largely eaten by the non-native fish species (Minckley et al. 1991). For example, a review of Lower Colorado River Basin stocking programs found survival of fish stocked to be less than 1%, and survival rates did not increase until fish were grown to large sizes prior to their release in the wild (Schooley and Marsh 2007).

Analysis and Determination of Effects

The management strategy outlined in the CFMP was developed in consultation with species experts, as well as several management agencies and tribes (Valdez et al. 2012b). Similar to humpback chub effects discussed above, fisheries sampling gear that may be used for initial inventory work and long-term monitoring proposed in the CFMP, such as electro-fishing equipment, trammel and hoop nets, seines, and other gear types, combined with stress that would be experienced by individual razorback sucker may result in some injury or mortality. Initial sonic-telemetry studies using 15-25 wild adult razorback sucker collected from grow-out ponds (previously collected as larvae from Lake Mead), and released into GCNP may result in mortality of up to about 25 adults per year during the study. However, insertion of sonic-tags would be performed by trained and experienced personnel, resulting in less risk of mortality. The exact numbers to be used in the study would be determined through ESA section 10 permitting process, consultation and coordination with USFWS, Nevada Department of Wildlife, AZGFD, and other agencies, and would be dependent on the availability of suitable fish. Fish taken from Lake Mead as larvae would be stocked within the full pool elevation of Lake Mead (Separation Canyon), since quagga mussel is present in Lake Mead, subject to state and federal permitting. Individuals inserting sonic-tags into the fish will be appropriately trained to minimize mortality (Section 10 Recovery Permit). Tracked adults could possibly lead to the identification of spawning areas and suitable spawning habitat, or could lead researchers to other wild adults, which would assist in determining the status of the species in GCNP. Larval and small-bodied fish sampling as part of Phase 1 (described above) would likely result in mortality of larval individuals if they are present, because lethal sampling would need to take place for laboratory processing of samples. However, the likelihood these individuals would survive and recruit to adulthood in GCNP would likely be low. The conservation value of documenting larval razorback sucker in GCNP, and thus spawning, would be extremely valuable for future conservation of the species. Collections also occur from Lake Mead itself for rearing and re-stocking purposes, outside of the scope of this CFMP.

Non-native fish monitoring, detection, and control efforts in GCNP included in the CFMP may benefit razorback sucker, however, most initial non-native control efforts would be focused on the Bright Angel Creek and Inflow FMZ, in addition to other locations where razorback sucker are likely absent. Razorback sucker have not been detected near Bright Angel Creek or the LCR since 1944 and 1990, respectively, which is where much of the benefit of brown trout control may be expected. Nevertheless, if a new invasion of a non-native species were detected, or an increase in abundance of other species was detected in the Lower Colorado River FMZ where the species is most likely to be found, action would be taken to reduce the threat and potentially benefit the species.

Other actions not specifically mentioned here such as triploid trout stocking in the Glen Canyon Reach FMZ triggered by severe declines in the rainbow trout fishery, Marble Canyon volunteer angler trips targeting trout for removal, and humpback chub translocations, would have minimal impacts on razorback sucker, either because the species has not been found in the area where these actions would be implemented recently, or the activity would have no impact even if the species was present (outside of potential handling stress discussed above).

Cumulative Effects

Cumulative effects are the result of those actions that can be reasonably expected to be taken by state, private, or tribal organizations that may impact razorback sucker individuals or habitat in addition to those taken by the actions proposed in the CFMP. The most likely area for management actions, outside of federal actions that would be considered through separate section 7 consultations, which may impact razorback sucker, would be in the Lower Colorado River FMZ where a large amount of land is managed by the Hualapai Indian Tribe. However, there are no known plans by the Hualapai or other entities to conduct any sort of management action that would add to the effects described here for the CFMP. Coordination with the Hualapai Wildlife Department and Tribal Government would continue as actions are planned and implemented.

Summary

In summary, while overall, the proposed action would have beneficial impacts to razorback sucker, some elements of the CFMP have the potential to directly impact razorback sucker negatively through disturbance, injury, and mortality. Therefore, NPS has determined the proposed action ***may affect, and is likely to adversely affect*** individuals, but will not likely have adverse impacts at population levels.

Critical Habitat and Determination of Effects

Critical habitat was designated in 15 river reaches in the historical range of the razorback sucker on March 21, 1994 (59 FR 13374), with an effective date of April 20, 1994 (USFWS 1994). Critical habitat includes portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White, and Yampa Rivers in the Upper Colorado River Basin, and the Colorado, Gila, Salt, and Verde rivers in the Lower Colorado River Basin.

The primary constituent elements for critical habitat of the razorback sucker include five features: space for growth and normal behavior; food, water or other nutritional or physiological requirements; cover or shelter; breeding and rearing sites; habitats protected from disturbance or representative of geographical and ecological distributions (Maddux et al. 1993, USFWS 1998b). When considering the element of water, both quality and quantity are important. Water quantity refers to the amount of water that must reach specific locations at a given time of year to maintain biological processes and to support the various life stages of the species. Some factors used to determine appropriate water quality include temperature, dissolved oxygen, environmental contaminants, nutrients, and turbidity (USFWS 1998b). When looking at the physical habitat in the Colorado River system, areas that could be suitable for spawning, nursery, rearing, and feeding, such as main and side channels, oxbows, backwaters , floodplains, and secondary channels are necessary for critical habitat (USFWS 1998b). The biological environment should provide living components of the food supply and interspecific interactions (USFWS 1998b).

Within GCNP critical habitat has been designated for the entire stretch of the Colorado River from Paria River to the boundary with Lake Mead National Recreation Area. The quality and quantity of this portion of the Colorado River is controlled by the operations of GCD and habitat conditions can change drastically due to those operations. NPS has determined that the actions of this plan will have ***no effect*** to the critical habitat of the razorback sucker.

Conservation Measures
Electro-fishing:

- Electro-fishing gear will be set to avoid injury to native fish.
- Block nets will be used during multiple-pass depletion electro-fishing where native fish are present to minimize applying electrical current to individual fish multiple times. Fish will be released downstream of block nets and outside the sampling area between passes.
- The least-intensive electro-fishing settings that effectively sample fish will be used in all cases. For example, during tributary electro-fishing in Grand Canyon, a pulsed-DC at a frequency of 30-40 Hz (300-350 volts) has proven to be sufficient.
- Fish captured using electro-fishing will be monitored in buckets or live wells, and gear settings would be adjusted if sufficient recovery is not observed.
- Crew members will be sufficiently trained in electro-fishing techniques.
- Netters and electrodes will be positioned so that fish can be removed from electrical fields as quickly as possible.

General Fish Handling:

- Trammel net use will be minimized when possible, and will not be used if water temperatures exceed 20°C. Trammel nets would be checked every 2 hours or less.
- The feasibility of the use of experimental mobile PIT tag antenna probes, where no handling of fish is necessary, will be determined, and considered for future sampling in lieu of handling PIT tagged razorback sucker.
- During sampling efforts, all native fish will be processed first and handling time on captured razorback sucker will be minimized whenever possible
- If incidental mortality occurs, razorback sucker otoliths will be extracted and preserved (if feasible) and preserved in 100% ethanol, otherwise the entire fish will be preserved as above and deposited into GCNP's museum and made available for scientific purposes
- "General Guidelines for Handling Fish" published by the USGS-GCMRC to minimize injury to fish would be followed during all field projects (see Persons et al 2013).
- No bait, or an artificial or natural substance that attracts fish by scent and/or flavor (i.e., live or dead minnows/small fish, fish eggs, roe, or human food), would be used by anglers participating in non-native fish control efforts. Barbless hooks would be used for trout removal activities.

Aquatic Nuisance Species:

- Appropriate measures, as determined through consultation with the AZGFD, USFWS, and Nevada Division of Wildlife, will be taken to minimize the risk of transfer of Dreissenid mussels or other aquatic nuisance species into GCNP with razorback suckers destined for release in GCNP.
- To prevent inadvertent movement of disease or parasitic organisms among fish sites, research and management activities shall conform to the Declining Amphibians Population Task Force Field work Code of Practice (www.nrri.umn.edu/NPSProtocol/pdfs/Amphibians/Appendix%20B.pdf), with the exception that 10% bleach solution or 1% quarternary ammonia should be used to clean equipment rather than 70% ethanol. Abiding by this code will effectively limit the potential spread of pathogens via fish sampling equipment.

Interagency Coordination:

- All sampling activities will be coordinated with AZGFD (according to 43 CFR part 24) and the USFWS Arizona Fish and Wildlife Conservation Office, as well as other agencies performing fish monitoring within the project-area.
- Annual reports documenting CFMP implementation and monitoring conducted by the NPS will be provided to USFWS, AZGFD, BOR, USGS and other interested parties.
- Monthly, or at least bimonthly, conference calls (or written status updates in lieu of a call) will continue to be held by the NPS Fisheries Program to update interested parties on ongoing or new NPS fisheries management activities.

California Condor

Status and Background

The California condor (*Gymnogyps californianus*) was listed as an endangered species in March 1967 (USFWS 1967, 32 FR No.48; 4001). In 1996, the third revision to the recovery plan modified previous recovery strategies that focused primarily on habitat protection, to emphasize the captive breeding program and intensive efforts to reestablish the species in the wild (USFWS 1996a). Following that revision, the USFWS established a "nonessential, experimental population" ("10j") of California condors in northern Arizona delineated by a 10j boundary in northern Arizona and southern Utah (USFWS 1996b). In December 1996, the first condors were released in the Vermilion Cliffs area of Coconino County, Arizona, approximately 30 miles (48 km) north of GCNP. Subsequent releases have occurred during 1997- 2012 in the same vicinity and Hurricane Cliff area, which is about 60 miles west of Vermilion Cliffs. AZGFD lists the California condor as a Species of Special Concern; however, within GCNP and other national parks within the 10j area, the condor has the full protection of a threatened species.

Condors are members of the New World vulture family, feeding exclusively on carrion such as deer, cattle, rabbits, and large rodents. Using thermal updrafts, condors can soar at up to 50 miles per hour and travel 100 miles or more per day, reaching altitudes of 15,000 feet to seek food while expending little energy. California condors typically forage in open terrain, although in GCNP foraging does occur in forested areas on deer and elk carcasses. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling flights over a carcass and hours of waiting at a roost or on the ground near a carcass. When not foraging, condors spend most of their time perched at a roost such as, cliffs, tall conifers, and snags (USFWS 1996a).

Condors are long-lived species with low reproductive rates, living up to 60 years in the wild, and become sexually mature at six or seven years of age. Condors create nests in rock formations such as caves, crevices, and potholes (USFWS 1996a). Courtship begins in December, and breeding pairs lay a single egg between late January and early April. Eggs hatch after approximately 56 days, and young condors take their first flight at approximately six months. Young condors may be dependent on parents through the following breeding season (USFWS 1996a). Without the guidance of their parents, young, inexperienced juveniles may also investigate human activity. As young condors learn and mature, this human-directed curiosity diminishes.

Distribution and Population Status

As of March 2013, the population of wild condors in Arizona is 73. All northern Arizona condors are fitted with radio transmitters allowing field biologists to monitor their movements. California condor nesting habitat is generally limited to cliffs and caves in the redwall limestone of the inner canyon. Based on GPS location point data, condors have been documented flying, perching, and nesting throughout GCNP with concentrations of activity at the South Rim and Marble Canyon areas. Condors are active year-round at the South Rim and Marble Canyon, however, a growing number of condors typically begin visiting the Marble Canyon portion of the Colorado River corridor in February, March, and April (NPS 2005). Condors are at rim level less frequently in winter and are more often seen along the river corridor during this time. Within GCNRA, California condors are rare local permanent residents with most activity occurring between the GCD and Navajo Bridge (Spence et al. 2011).

California condor nesting habitat at GCNP is limited to cliffs and caves in the inner canyon. The first nesting attempt in the park was confirmed in 2001 in the Marble Canyon area. Condors have nested in GCNP every year since with nests documented in the [redacted] Appendix A, Figure 10). The first wild-reared chick in the program's history, and likely the first chick in Arizona in 100 years, fledged November 2003. Since then, seven chicks have fledged in the park. During the 2012 breeding season, condors at GCNP were located nesting [redacted] nest failed due to unknown causes, and the [redacted] chick was found dead below the nest cave (cause of death unknown). The first nesting attempt in GCNRA was confirmed in 2012 in the Glen Canyon Reach area.

Threats

Little information exists to document the precise causes for the decline of the condor, but reasons were probably diverse. One main cause for the decline was an unsustainable mortality rate of free-flying birds combined with a naturally low reproductive rate. Most deaths in recent years have been related to human activity. Shootings, poisonings, lead poisoning, and power line collisions are considered the condor's major threats. In GCNP, the leading cause of mortality has been lead poisoning from foraging on carcasses shot with lead ammunition.

Analysis and Determination of Effects

The focus of this analysis will be on the potential for impacts to condors that could be attracted to project areas during fisheries management activities, and noise disturbance from helicopter flights in and out of the canyon transporting live fish, staff, and project equipment.

The main concern with California condors in relation to implementing the CFMP is the potential for contact with humans. Condors are naturally curious and it is not uncommon for them to be seen frequenting areas of high human activity. The noise and activity associated with management activities has the potential to attract condors to project sites and can increase the potential for interaction between condors and humans. Fisheries crews would generally consist of small groups of up to 4-8 people. Conservation Measures to educate work crews of condor concerns and to cease activities if condors are present would reduce potential disturbance from management activities to the birds. To date, condors have not been observed near NPS fisheries projects.

California condor nesting and roosting habitat is generally limited to cliffs and caves in the inner canyon. The activities of the proposed CFMP will take place along the mainstem Colorado River and in tributaries within GCNP. There is potential for these activities to occur in the vicinity of condor nest/roost areas. Crews may also need to travel through these areas to get to a project site, however, it is expected that crews will use established trails and therefore will not contribute measureable disturbance to condors when compared to current conditions.

Helicopters would be utilized for transporting live fish, staff, and project equipment to various locations in the inner canyon. There is potential for direct noise disturbance to condors, however, Conservation Measures to minimize the potential for noise disturbance to condors during the breeding season are listed below. These measures are currently implemented at GCNP and have previously been included in other Biological Opinions for the park (USFWS 2000, 2009a, 2009b, 2012a).

Based on the distance helicopters and work crews would maintain from known roost/nest sites, and the short-term duration of noise, the NPS determines that the proposed action ***may affect, but is not likely to adversely affect*** the California condor.

<u>Critical Habitat and Determination of Effects</u>

Currently, critical habitat is designated only in California for the species (USFWS 1976, 41 FR No. 187; 41914). The proposed action would have ***no effect*** on critical habitat.

<u>Conservation Measures</u>

- Keep areas free of trash and other materials
- Provide all personnel with educational information about condors before field work commences. This educational information will emphasize appropriate interactions with condors
- Record and report immediately any condor presence in the project area to the GCNP Wildlife Department
- Avoid any condors that arrive at any area of human activity associated with fish management activities. Notify GCNP Wildlife Department, and only permitted personnel will haze the birds from the area
- Minimize aircraft use along the rim to the greatest extent possible
- Keep aircraft at least 400 meters (437 yards) from condors in the air or on the ground unless safety concerns override this restriction.
- Aircraft will give up airspace to the extent possible, if airborne condors approach aircraft, as long as this action does not jeopardize safety
- Planned fisheries projects involving mechanized equipment will not occur within 0.5 miles of active condor nesting sites during the breeding season (February 1 – September 30)
- Crews will stop activity on projects if condors arrive on site
- GCNP will continue to work closely with The Peregrine Fund, USFWS, and AZGFD to determine condor use patterns and breeding sites
- Any crew access necessary within .25 miles of an active nest site during the breeding season will be limited to established roads and trails. If access off designated roads or trails or camping is necessary during the breeding season, only activities that occur greater than .25 miles from any known or suspected nest area may be conducted. Such situations will be coordinated with GCNP's Wildlife Department.
- Prior to the start of any fisheries management activities for the year, GCNP's Wildlife Department will be contacted for any new information related to condors or their status near the project area. Condor location maps will be updated annually with any new

information to ensure consistency with the above measures and will be referenced when annual work plans are developed.

Mexican Spotted Owl

Status and Background

The Mexican spotted owl (MSO) (*Strix occidentalis lucida*) was listed as a threatened species in March 1993 (USFWS 1993, 58 FR 14248) and portions of GCNP were designated as critical habitat in February 2004 (USFWS 2004b, 69 FR 53182). A recovery plan for the MSO was first published in December 1995 and has recently been revised as of December 2012 (USFWS 2012b). Six Recovery Units were identified in the original recovery plan to allow for specific recovery strategies for each area. In the plan revision, Recovery Units have been renamed "Ecological Management Units" (EMU); GCNRA and GCNP are located within the Colorado Plateau EMU. Federal lands account for 46% of this EMU and of the documented owl sites recorded in this EMU, 64% have been located on NPS lands (USFWS 2012b).

MSOs are known to occur in Arizona, New Mexico, Utah, Colorado, and Mexico and are typically associated with late seral forests. MSO are generally found in habitat that includes mixed conifer and pine-oak forests, riparian madrean woodland, and sandstone canyonlands (USFWS 1995a). However, MSO have been found in relatively open shrub and woodland vegetation communities in arid canyonland habitat (Ganey 1988), contrary to the typical mature forest habitat believed to be the classic norm.

Nest and roost sites of MSO are primarily in closed-canopy forests or rocky canyons. Breeding occurs between March and August annually. Females normally lay one to three eggs, two being the most common (Gutiérrez et al. 2003). Forests used for roosting and nesting often contain mature or old growth stands with complex structure. These forests are typically uneven-aged, multistoried, and have high canopy closure. MSOs do not build nests, but use naturally occurring sites, often in large diameter trees, cliff cavities, and abandoned hawk or raven nests. Protected Activity Centers (PAC), determined using several detection criteria, each encompass about 600 acres surrounding known owl sites and are intended to protect the activity center of a single owl territory (USFWS 2012b).

Spotted owls are primarily nocturnal and prey mainly on small mammals, particularly arboreal or semi arboreal species. Birds, insects, reptiles and other types of small mammals are taken as well; prey species composition varies with cover type. MSO are known to occur in cool canyon habitat within GCNP defined as low thermal intensity, short thermal duration, and steep slopes (Spotskey and Willey 2000).

GCNP Distribution and Population Status

GCNP MSO presence was confirmed in 1992 through field surveys. To understand the distribution and abundance of spotted owls in GCNP, the park initiated inventory for spotted owls within both forest and rocky canyon habitats in the mid-1990s. MSO were located by mimicking spotted owl vocalizations along canyon rims and within canyons at night to illicit vocal responses from resident owls (Forsman 1983, USFWS 2003). Rim surveys involved standing at a point along the rim and calling for a minimum of 15 minutes. Canyon surveys involved hiking along canyon bottoms searching for owls. Both point and continuous calling survey methods (USFWS 2003) were used during the canyon surveys.

As a result of surveys to ground-truth potential habitat modeling, additional MSO individuals (60) have been located and a total of 40 MSO PACs exist within the park covering 30,285 acres. The average size per PAC at GCNP is 757 aces. The 40 PACs have been found below the rims in side-canyons of GCNP; however owls have been located on the rims of the canyon as well. Five PACs have been extensively studied and mean home range estimates (using the fixed kernel 90% isopleth estimator) for MSO PACs at GCNP is 919 ac (371.93 ha, ± 59.56 SD). To date, the number of acres of MSO canyon nest/roost potential habitat determined from predictive models stands at 1,860 acres within GCNP (Spotskey and Willey 2000).

Surveys from 1998 through 2010 elicited few responses from MSO in the forested plateaus of the park with the majority of locations found below plateau rims (Bowden et al. 2010). Park-wide surveys located MSO within rocky canyon habitat below the main canyon rims (Bowden 2008; Willey and Ward 2003). Predicted canyon habitat may or may not include patches or stringers of forest habitat, i.e. the coolness and short thermal duration may be a result of vertical rock faces, cliff walls and aspect and not necessarily because an area has dense vegetative cover.

GCNP biologists conducted a three-year radio-tracking study from 2004 to 2006 to describe the breeding ecology of GCNP MSOs and provide a foundation for a long-term nest monitoring program. Data analysis and field observations indicated that roost and nest sites were located toward heads of canyons and within the redwall limestone geologic layer (Bowden 2008). These areas were shady and generally included some tree and shrub vegetation. No roost or nest sites were found above the rim on the forested plateau of the North or South Rim. MSO were infrequently found foraging on the North Rim plateau within 2 miles of the side canyon used for nesting or roosting. MSO were also observed (i.e. responding to calls) on North and South Rims during surveys (Bowden 2008).

Threats

The primary threat cited for recovery of the MSO in most EMUs (as updated in the 2012 revised Recovery Plan) is large-scale catastrophic stand-replacement wildfire. Threats from predation, disease, parasites and starvation, and accidents are considered comparatively minor to stand-replacement wildfire (USFWS 2012b). Potential threats cited specifically for the Colorado Plateau EMU focus more on recreational impacts, road building, and overgrazing.

Analysis and Determination of Effects

Fisheries management activities have the potential to impact MSO through noise disturbance associated with activity in the vicinity of known owl locations in side canyons as well as helicopter flights carrying live fish, staff, and project equipment.

Research on the potential for human disturbance to raptors is varied and includes multiple species including ospreys, eagles, goshawks, peregrine falcons, and kestrels, and to a limited extent, owls. Recommendations for protecting raptors from human disturbance has been reviewed by Richardson and Miller (1997) and indicates that a common spatial buffer zone used for many raptor species to mitigate potential adverse noise impacts is 2,625 ft (800 m or approximately 0.50 miles). This distance was primarily the result of a 1979 compilation of studies (Call 1979) that suggested buffers surrounding raptor nests between .25 and 1 mile. Olendorff et al. (1980) recommended 0.25 mile buffers around known bald eagle nests during the breeding season. As indicated by the recent guidance from the USFWS (2007b), this 0.50 buffer zone is still in use, and represents a conservative approach to minimizing the potential for noise impacts to MSO, in absence of specific research results on the topic.

MSO seem to prefer GCNP's habitat of steep canyons below the rim. This suggests aircraft would often be obscured from MSO, but high canyon walls may also amplify sound and repeat it through echoes in specific locations. In Delaney et al. 1999, MSO showed an alert response when aircraft were an average 1,322 ft (403 m) from the owls, and no response at distances greater than 2,165 ft (660 m). Potential for eliciting flushing responses and increased metabolic costs exists (NPS 1999) and negative effects may occur to birds not habituated to these impacts (Bowden et al. 2010).

Determination of noise impacts on MSO is difficult, but based on the distance helicopters would maintain from PAC boundaries, the short-term duration of noise, as well as the fact that MSO and aircraft generally do not occupy the same air space simultaneously, the NPS determines that the proposed action ***may affect, but is not likely to adversely affect*** the Mexican spotted owl.

Critical Habitat and Determination of Effect

Critical habitat[1] for MSO was designated in 2004, comprising approximately 8.6 million acres on Federal lands in Arizona, Colorado, New Mexico, and Utah (69 FR 53182, USFWS 2004). Within the Critical Habitat Unit CP-10 boundaries, critical habitat is subdivided into protected areas, restricted areas, and other forest and woodland types as defined in the original Recovery Plan (USFWS 1995a). It has been defined in a Final Rule that only habitat within the Critical Habitat Unit that contains one or more primary constituent elements (related to forest structure, prey abundance, and canyon habitat) is considered critical habitat for the purposes of section 7 consultation (USFWS 1995a). Therefore, critical habitat for MSO in GCNP includes PACs (30,285 acres) and mixed conifer areas on the North Rim (27,079 acres), totaling 57,364 acres (Appendix A, Figure 11). The CFMP does not propose any activities on the North Rim of GCNP or activities that would alter inner canyon critical habitat and therefore determines ***no effect*** to designated MSO critical habitat.

[1] Critical habitats include all known owl sites, and all areas in mixed conifer or pine-oak forests with slopes >40% where timber harvest has not occurred in the past 20 years, and all reserved lands. Restricted habitat is the area on the North Rim of Grand Canyon in the mixed-conifer forest type which contain primary constituent elements.

Conservation Measures for Mexican Spotted Owls

- To the maximum extent possible, aircraft will remain at least 1,200 feet (400 meters) from the boundary of any designated PAC
- Locate areas associated with fisheries management activities, at least 400 meters (437 yards) from the boundary of any designated PAC
- Notify GCNP Wildlife Department if MSO are discovered during any projects
- As resources allow, GCNP will continue to survey MSO predicted habitat and known PACs for owl presence and breeding activity
- Inform all field personnel who implement any portion of the proposed action about MSO regulations and protective measures
- Most fisheries management activities would take place outside of the MSO breeding season (March 1- August 31). In instances when fisheries activities are scheduled during MSO breeding season and/or within a designated PAC or unsurveyed habitat, GCNP's Wildlife Department will be contacted before activities commence
- Integrate data from reports to USFWS on fisheries management activities into adaptive management processes
- If camping is necessary in a designated PAC or within unsurveyed predicted habitat during the breeding season, only those activities greater than .25 miles from any known or suspected nest/roost/core area may be conducted. Such situations will be coordinated with the park Wildlife Department
- Prior to the start of any fisheries management activities for the year, GCNP's Wildlife Department will be contacted for any new information related to MSO or their status near the project area. MSO location and habitat maps will be updated annually with any new information to ensure consistency with the above measures and will be referenced when annual work plans are developed.

Southwestern Willow Flycatcher

Status and Background

The southwestern willow flycatcher (*Empidonax traillii extimus*) is one of four currently recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948; Stiles and Skutch 1989; Peterson 1990; Ridgely and Tudor 1994; Howell and Webb 1995). On March 29, 1995, the southwestern willow flycatcher was designated as endangered (USFWS 1995b, FR 60, No.38, 10694) in its entire range, which is known to include Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico.

In August 2002, the USFWS released the "Final Recovery Plan for the Southwestern Willow Flycatcher". The Recovery Plan establishes six recovery units that are further subdivided into management units. These Recovery and Management Units are based on watershed and hydrologic units within the breeding range of the flycatcher (USFWS 2002c). GCNP and GCNRA fall within the Lower Colorado Recovery Unit. This Recovery Unit encompasses the Colorado River and its tributaries from GCD downstream to the Mexican border. Despite the large size of this Recovery Unit, the unit contains only 146 known territories (15% of the range-wide total) (USFWS 2002c).

The southwestern willow flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado. Throughout its range the southwestern willow flycatcher arrives on breeding grounds in late April and May (Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994, Muiznieks et al. 1994, Maynard 1995; Sferra et al. 1995, 1997). Nesting begins in late May and early June and young fledge from late June through mid-August (Willard 1912, Ligon 1961, Brown 1988a, 1988b, Whitfield 1990, Sogge and Tibbitts 1992, Sogge et al. 1993, Muiznieks et al. 1994, Whitfield 1994, Maynard 1995). The entire breeding cycle, from egg laying to fledging, is approximately 28 days. Nesting occurs during the spring and early summer months (May 1 ¯ August 31) in the GCNP.

Historical egg/nest collections and species descriptions throughout its range identify the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948, Phillips et al. 1964, Hubbard 1987, Unitt 1987, San Diego Natural History Museum 1995). Other habitats are also used, including non-native species such as tamarisk (*Tamarix spp.*) and Russian olive (*Eleagnus angustifolia*). Throughout the southwestern willow flycatcher's current range, suitable riparian habitats tend to be rare, widely separated small and/or linear locales separated by vast expanses of arid lands.

Distribution, Population Status, and Habitat Condition

Seventeen flycatcher sites were identified in the 2002 Recovery Plan (USFWS 2002c) within the GCNP. Flycatcher territories in GCNP are generally located in the tamarisk-dominated riparian vegetation along the river corridor but not in the mesquite-acacia and hackberry-dominated habitats higher on the slopes (Sogge et al. 1997). The flycatcher's nesting habitat is dynamic in that it varies in occupancy, suitability, and location over time. In GCNRA, southwestern willow flycatchers are uncommon restricted migrants in riparian areas, rare summer residents, and probable breeders (Spence et al. 2011). Historic and recent nesting site locations in GCNP have been documented below Lees Ferry in Marble Canyon and in lower Grand Canyon below Diamond Creek (RM 225.5-277) (Appendix A, Figure 12). There have been no southwestern willow flycatcher nests or nesting behavior identified in the inner gorge (RM 77.9 – RM 116.5); however, migrant birds have been documented. Because river channels, river flows, and floodplains are varied and can change over time, the location and quality of nesting habitat may also change over time. This is especially noticeable in lower Grand Canyon where dropping lake levels in Lake Mead have resulted in high walls (approximately 10 to 20 feet high in many areas) of sediment topped with tamarisk bordering the Colorado River. The backwaters and saturated soils preferred by southwestern willow flycatchers have become rare.

Numbers of southwestern willow flycatcher detections in GCNP have declined since the 1980s. There is little information on the number of willow flycatchers along the river before the construction of the GCD. However, what data are available suggests that southwestern willow flycatchers were not common breeders along the Colorado River in GCNP (Brown 1988a, 1988b, Brown 1991, Sogge et al. 1997). Studies conducted along the river from 1982-1991 between Lees Ferry and Phantom Ranch found a total of 47 adult southwestern willow flycatchers, 14 pairs, and 15 nests (Brown, 1988, Sogge et al., 1997). From 1992 - 2001, the breeding population fluctuated between one and four breeding pairs per year with a total over the 10 years of 66 adult southwestern willow flycatchers, 14 pairs, and 20 nests (Brown 1988a, 1988b, Brown 1991, Sogge et al. 1997, Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994, Sogge et al. 1995, Petterson and Sogge 1996, Sogge et al. 1997, Sogge 1998, Yard 2001, Yard 2002, Yard 2003). Appendix D summarizes southwestern willow flycatcher observation data, territories and nesting sites located in GCNP; 1909 – 2011. Although surveys were conducted in 2012, southwestern willow flycatchers were not detected. Survey methods followed the most recent USGS survey protocol, at the time of survey, and involved use of broadcast calling to elicit responses from nesting birds (Sogge et al. 2010). Figure 12 in Appendix A illustrates detections and nests from 1982-2011. Data is based on the following monitoring reports: Sogge et al.,1997; McKernan, 1997; McKernan and Braden 1998, 1999, 2000, 2001, 2002, 2004; Paradzick et al. 2001; Smith et al. 2002, 2003, 2004; Koronkiewicz 2004, 2005, 2006, 2007, 2008; Yard et al. 2004; Leslie, pers.com 2002; Albert 2005; Laczek-Johnson and Ward 2006; Ward and Haynes 2007; Northrip et al. 2008; Slayton et al. 2009; Palarino et al. 2010; Stroud-Settles and Lawrence 2011.

After the 2004 survey season, USGS-GCMRC elected to discontinue their monitoring of known southwestern willow flycatcher nesting habitat in GCNP. Beginning in 2005, GCNP conducted annual surveys from Lees Ferry to Phantom Ranch, but funding prevented surveying the isolated habitat patches between Phantom Ranch and Diamond Creek. From 2004 to 2008, only two southwestern willow flycatchers were detected between Lees Ferry and Phantom Ranch.

Lees Ferry to Diamond Creek

Suitable habitat is located disjunctly through the river corridor from approximately RM 28.3 to RM 275. Surveys conducted between 1992 and 2004 indicated a small resident breeding population between Lees Ferry and Cardenas Marsh (RM 71), but no territories from RM 71 through RM 246 have been located. Recent surveys have only detected non-resident/ migratory flycatchers between Lees Ferry and Phantom Ranch (Palarino et al. 2010).

From 1993 to 2004, flycatchers were consistently present during the breeding season at RM [redacted] but have not been present since 2004 (Ward and Haynes 2007, Northrip et al. 2008). In 2003, 2004, and 2010 the area around [redacted] was occupied. Another area of importance in the mid-1990s was [redacted]; however, this area does not appear to have been occupied for the last 17 years. In 2004, GCNP instituted an emergency closure at two sites. This closure was in effect between May 1 and July 15 and included closure of visitor use, including hiking, camping, and river landings at [redacted] Closures at [redacted] have been put in place intermittently in the past; closure at Cardenas (RM 71) was instituted in the early and mid-1990s.

Lower Grand Canyon

Koronkiewicz et al. (2004) reported that the Colorado River in GCNP downstream of Separation Canyon (RM 234) is strongly influenced by water levels in Lake Mead. Potential willow flycatcher habitat in this area has changed dramatically in the last several years as the result of a 105 foot drop in the level of Lake Mead since 2000. Areas that were inundated in the late 1990s are now well above the current water level and the existing riparian vegetation in many of these areas is dead or dying.

Southwestern willow flycatchers have been regularly detected in lower Grand Canyon below RM 234 since 1995 with the exception of 2002, 2003, 2011, and 2012 (Appendix D). In 2004, Koronkiewicz et al. identified approximately 76 hectares of suitable habitat at several sites between RM 239 and 275 within GCNP. These disjunct habitat patches have been inconsistently monitored during the past 8 years for both flycatcher presence and habitat suitability. Suitability ranking of these sites has proven to be largely dependent on current hydrological conditions of the Colorado River. As a result, a habitat assessment survey conducted during one year may result in a habitat ranking that is deemed suitable, but a revisit to the same site during a different year may rank the site as only potential habitat.

Threats

The southwestern willow flycatcher has experienced extensive loss and modification of habitat and is also endangered by other factors, including brood parasitism by the brown-headed cowbird (*Molothrus ater*) (USFWS 1995b). The southwestern willow flycatcher was listed primarily due to riparian habitat reduction, degradation, and elimination as a result of agricultural and urban development. Other reasons for the decline/vulnerability of the flycatcher include: the fragmented distribution and low numbers of the current population; predation; and other events such as fires and floods that are naturally occurring, but have become more frequent and intense as a result of the proliferation of exotic vegetation and degraded watersheds, respectively.

Analysis and Determination of Effects

Impacts to southwestern willow flycatchers would be focused on the river/riparian habitat within the park which constitute the species' potential, suitable and existing breeding areas. As with other bird species, flycatchers may be disturbed due to increased human-generated noise during the breeding season. Fisheries management treatments have the potential for indirect increased noise from traveling through riparian areas to get to project sites, however, established trails and campsites will be utilized by fisheries crews, and therefore, impacts would not be measureable above current conditions. Proposed activities are water-based and seining and other fish sampling activities may occur near the banks in temporary, un-vegetated, backwaters that may be available depending on river water level/GCD discharge, but sampling could impact some shoreline vegetation (trampling) and cause some noise disturbance. The NPS determines the proposed CFMP will have ***no effect*** to southwestern willow flycatcher habitat and ***may affect, but is not likely to adversely affect*** the southwestern willow flycatcher.

Critical Habitat and Determination of Effects

Critical habitat was first designated in 1997, re-proposed in 2004, and again in 2013. Proposed critical habitat within GCNP (RM 234 – RM 277) was excluded in the final listing as the area is included in the Lower Colorado River Multi-Species Conservation Program. However, areas within the park were identified by the USFWS along the Colorado River from Spencer Canyon (RM 246) to the Lake Mead delta (RM 278) (USFWS 2013) that have high conservation value for the SWFL. The Southwestern Willow Flycatcher Recovery Plan (USFWS 2002c) indicates that this is the area where substantial recovery value exists with existing and potential nesting habitat. Critical habitat has not been designated in GCNP, and therefore this plan will have ***no effect*** on southwestern willow flycatcher critical habitat.

Conservation Measures

- Occupied southwestern willow flycatcher habitat would be avoided during the breeding season (May 1-August 31)
- Prior to the start of any fisheries management activities, the park's wildlife department would be contacted for any new information related to flycatchers, flycatcher habitat, and their status near the project area.
- Contingent upon availability of funding, GCNP will strive to conduct annual southwestern willow flycatcher –presence/absence, nest monitoring surveys, and on-the-ground monitoring of habitat throughout the action area that may be affected by fisheries management activities.
- No camping or sustained activities would occur, except at already established campsites, within occupied or unsurveyed flycatcher habitat (suitable or potential) unless it is outside the breeding season (May 1 – August 31)
- Travel to project sites would not occur in occupied flycatcher habitat
- Southwestern willow flycatcher location and survey maps will be updated annually with any new information to ensure consistency with the above measures and will be referenced when annual work plans are developed

Yuma Clapper Rail

Status and Background

The Yuma clapper rail (*Rallus longirostris yumanensis)* was listed as endangered on March 11, 1967 (32 Federal Register 4001). A five year review of the species was completed in 2006 and currently the 1983 recovery plan is in the revision process. Although the majority of the population is found in Mexico, the Yuma clapper rail is only listed as endangered in the United States. It is categorized as a subspecies with a high degree of threat and low recovery potential due to habitat loss. The Yuma clapper rail occurs along the lower Colorado River and tributaries (Virgin, Bill Williams, Lower Gila Rivers) in Arizona, California, Nevada, and Utah; the Salton Sea in California; and the Cienega de Santa Clara and Colorado River Delta in Mexico (USFWS 2009c). Between 2000 and 2008 the number of Yuma clapper rails in the United States has fluctuated between 503 and 890 (USFWS 2009c). Significant breeding areas in the United States include Mittry Lake (AZ), Imperial Reservoir, Imperial National Wildlife Refuge, Bill Williams River National Wildlife Refuge, Topock Gorge and Topock Marsh in Havasu National Wildlife Refuge, Cibola National Wildlife Refuge, Imperial Wildlife Area, Sonny Bono Salton Sea National Wildlife Refuge, and the Cienega de Santa Clara in Mexico.

The Yuma clapper rail is a secretive species and is not often seen in the wild; however it does have a series of distinctive calls and is most often identified by those. This bird inhabits freshwater or brackish stream-sides and marshes under 4,500 feet in elevation. It is associated with dense riparian and marsh vegetation, dominated by cattails (*Typha* sp.) and bulrush (*Scirpus* ssp.) with a mix of riparian tree and shrub species. Yuma clapper rails may climb into a shrub or tree, but overall they do not perch above the ground (USFWS 2009c). Clapper rails are capable of swimming and are also known to dive underwater, and may hold onto submerged vegetation to avoid threats or use its wings to "swim" (Todd 1986, Ripley 1977 cited in Eddleman and Conway 1998). The clapper rail requires a wet substrate such as a mudflat, sandbar or slough bottom that supports cattail stands of moderate to high density adjacent to shorelines. Other important factors are the presence of vegetated edges between marshes and shrubby riparian habitat (tamarisk or willow thickets) and the amount and rate of water level fluctuations. Nests are built three to six inches above the surface in sloughs and backwaters that support dense stands of bulrush and cattails, and breeding occurs from March to early July. Along the lower Colorado River males begin calling in February and pair bonding occurs shortly after. Non-native crayfish provide the primary food base for the clapper rail today; prior to the introduction of crayfish, isopods, aquatic and terrestrial insects, clams, plant seeds, and small fish likely dominated their diet (LCRMSCP 2008).

Eddleman (1989) determined vocalizations are significantly reduced in winter and telemetry data indicated that the majority of clapper rails do not migrate. There is evidence that some populations may be more migratory than others and this could be based on habitat and a stable food source (Eddleman 1989, Corman and Wise-Gervais 2005). Very little is known about the dispersal of adult or juvenile birds, but there is evidence of populations expanding northward along the lower Colorado River, the Salton Sea, and central Arizona over the last 80 years (LCRMSCP 2004).

Marsh bird surveys were conducted in 2009 by the LCRMSCP along portions of the lower Colorado River, adjacent backwaters, lakes, and marshes (Kahl 2012). The portion of GCNP included in the LCRMSCP (RM 234-RM 277) was not included in these surveys.

Distribution and Population Status

Yuma clapper rails have been recorded at GCNP between 1996 and 2001, however, information about the clapper rail and its habitat in lower Grand Canyon is extremely limited and surveys have not been conducted in the park in recent years (Appendix E). Within GCNRA, the western yellow-billed cuckoo is a rare restricted transient in dense riverside tamarisk thickets (Spence et al. 2011).

McKernan and Braden (1999) reported the presence of Yuma clapper rails between Spencer (RM 246) and the boundary of GCNP (RM 277); these observations were made while conducting southwestern willow flycatcher surveys in the area. Specifically, McKernan and Braden (1999) report at least one clapper rail observed between May 26, 1996 and June 30, 1996 and they indicate that nesting was confirmed. They report at least one clapper rail observed between May 14, 1997 and June 17, 1997, but indicate that nesting was not confirmed (McKernan and Braden 1997). In 2001, three individual Yuma clapper rails were observed in the vicinity of [redacted] by San Bernardino College (San Bernardino College pers. communication. 2001). Surveys for the southwestern willow flycatcher in 2004 did not record incidental detections for the Yuma clapper rail in GCNP (McLeod et al. 2005).

Habitat is present in a very limited quantity below RM 225.5 in GCNP. Koronkiewicz et al. (2004) and McLeod et al. (2005) report the presence of live cattails at Spencer Canyon (RM 246) and Burnt Springs (RM 259.5). Again, the observation of cattails was made as part of habitat observations while surveying for southwestern willow flycatcher habitat between Spencer Canyon and the western GCNP boundary. It is not known if such habitat is present in sufficient quantity to allow for nesting.

Because of the limited information about the Yuma clapper rail and its habitat in GCNP, the park must rely heavily upon that information available. Given Yuma clapper rails have been recorded historically at GCNP but have not been surveyed consistently or recently, GCNP presumes that the Yuma clapper rail may be present in lower Grand Canyon during the lifetime of this CFMP.

Threats

Historically, the primary concentrations of Yuma clapper rails were likely found in cattail/bulrush marshes in the Colorado River Delta. Unfortunately, due to diversions from the river for agriculture and municipal uses, the freshwater flows down the lower Colorado River, necessary to maintain marsh habitat, have virtually been eliminated (USFWS 2009c). The majority of Yuma clapper rail habitats that exists today are mostly human-made, such as the managed ponds at the Salton Sea (USFWS 2009c). Without active management and protection of water resources to address land use changes in floodplains, human activities, environmental contaminants, and reductions in connectivity between core habitat areas, these habitats will be permanently lost to the Yuma clapper rail (USFWS 2009c).

Another specific threat to the Yuma clapper rail includes selenium in crayfish, the major prey item of the species. Selenium levels in crayfish collected in Yuma clapper rail habitat were high enough to cause concern for the rail's reproductive effects (USFWS 2009c). No adverse effects from selenium have been observed; however, due to the clapper rail's secretive nature, nests are very difficult to find and young birds difficult to observe (USFWS 2009c).

Analysis and Determination of Effects

Impacts to Yuma clapper rails would be focused on the river/riparian habitat within the park which constitute the species' potential and suitable breeding areas. As with other bird species, Yuma clapper rails may be disturbed due to increased human-generated noise. Fisheries management treatments have the potential for indirect increased noise from traveling through areas to get to project sites, and nearshore project activities; however, established trails and campsites will be utilized by fisheries crews, and therefore, impacts would not be measureable above current conditions. Proposed activities are water based and are not intended to occur at Yuma clapper rail historical locations, but could impact some shoreline vegetation (trampling) and cause some noise disturbance. The NPS determines the proposed CFMP will have ***no effect*** to Yuma clapper rail habitat and ***may affect, but is not likely to adversely affect*** the Yuma clapper rail.

Critical Habitat and Determination of Effects

Critical Habitat has not been designated for the Yuma clapper rail.

Conservation Measures

- As funding allows, GCNP will conduct surveys for the Yuma clapper rail in lower Grand Canyon. Such surveys may be combined with surveys for breeding birds and/or southwestern willow flycatchers. Surveys should be conducted once every 3 years for the life of the CFMP.
- If Yuma clapper rails are found in GCNP during the breeding season or if nests are located, GCNP will restrict project activities in or adjacent to suitable breeding habitat in the area, with an appropriate buffer, during the length of the breeding season (March 1-July 1).
- Prior to the start of any fisheries management activities, the park's wildlife department would be contacted for any new information related to clapper rails, clapper rail habitat, and their status near the project area
- Fisheries management crews would avoid walking through and/or disturbing dense riparian vegetation, especially where cattails and/or bulrush are present

Western Yellow-Billed Cuckoo

Status and Background

The future of the western yellow-billed cuckoo (*Coccyzus americanus*), a neotropical migrant that breeds throughout northern Mexico, the United States, and southern Canada, is uncertain (Hughes 1999). Western yellow-billed cuckoo populations have declined throughout the species' range (Hughes 1999); western populations, in particular, have decreased and suffered catastrophic range reductions in the twentieth century (Laymon and Halterman 1987; Hughes 1999; Corman and Magill 2000). In 2001 the USFWS determined that the western yellow-billed cuckoo represents a distinct population segment and concluded that federal listing was warranted, but the action was precluded by higher priority listing actions and the species became a Candidate Species under the ESA (USFWS 2001, FR66, 143: 38611). The state of California lists the western yellow-billed cuckoo as endangered (CDFG 1978), and the state of Arizona lists it as a species of special concern (AZGFD 1988). Probable factors believed to be contributing to population declines are the loss, fragmentation, and alteration of native riparian breeding habitat, the possible loss of wintering habitat, and pesticide use on breeding and wintering grounds (Corman and Magill 2000).

The western yellow-billed cuckoo is a late migrant associated with large tracts of riparian deciduous forest where willow, cottonwood, sycamore, or alder occur. Cuckoos begin arriving in Arizona and California in late May (Bent 1940, Hughes 1999). Nesting usually occurs between late June and late July, but can begin as early as late May and continue to late September (Hughes 1999), and may be triggered by an abundance of cicadas, katydids, caterpillars, or other large prey which form the bulk of the species' diet (USFWS 2001).

Yellow-billed cuckoos' secretive nature and infrequent calling, together with large home ranges and short nesting period make them challenging to study (Laymon et al. 1997, Hamilton and Hamilton 1965, Halterman 2008). Cuckoos have the shortest nesting cycle among birds, a minimum of 16 days between egg and fledging (Payne 2005). In addition to these difficulties, cuckoos often display avoidance behavior or avoid moving when surveyors are observed. Telemetry observations in 2009 and 2010 show many cuckoos detected are transitory and do not stay on-site long (McNeil et. al 2010).

The LCRMSCP covers areas within the historical floodplain of the Colorado River from Lake Mead to the United States-Mexico Southerly International Boundary, a distance of about 400 river miles (LCRMSCP 2004). Developed between 1996 and early 2005, the LCRMSCP includes the creation of more than 3,278 hectares (8,100 acres) of riparian, marsh, and backwater habitat for six listed species and 21 other species native to the lower Colorado River, including at least 1,639 hectares (4,050 acres) of habitat for the riparian obligate yellow-billed cuckoo (LCRMSCP 2004).

In 2010, 46 sites were surveyed for the LCRMSCP resulting in 272 western yellow-billed cuckoo detections. Of these, 56 potential breeding pairs were estimated (22 confirmed), a 30% increase from 2008 and 2009 estimates (McNeil et. al 2011).

Arizona probably contains the largest remaining western yellow-billed cuckoo population among the states west of the Rocky Mountains; half of all survey detections in 2010 were at Bill Williams National Wildlife Refuge (>140) and the Cibola Valley also had a relatively high number of detections (26-40) (McNeil et. al 2011).

<u>GCNP Distribution and Population Status</u>

Corman and Magill (2000) report that western yellow-billed cuckoos were detected prior to 1998 in the following general locations on the Colorado River above Lake Mead:

Lees Ferry
Phantom Ranch
Supai
Havasu Canyon
Lake Mead Delta

During surveys in 1998 and 1999, Corman and Magill (2000) report that western yellow-billed cuckoos were detected on the Colorado River (above Lake Mead) at the Lake Mead Delta. However, it does not appear that surveys during those years (1998 and 1999) included habitat further upstream on the Colorado River.

In 2001, one individual western yellow-billed cuckoo was observed in the vicinity of [redacted] by San Bernardino College (pers. comm. San Bernardino College to Elaine Leslie, 2001). While a portion of GCNP falls within the Lower Colorado River MSCP area (RM 234-RM 277), surveys have not taken place within the park in recent years.

Habitat is present in a very limited quantity below RM 225.5 in GCNP. Based upon detections prior to 1998, suitable nesting habitat may be present within the upper portion of the project area, however, surveys have been extremely limited to date within lower Grand Canyon (RM 225.5 - 277) and non-existent in the remainder of the Colorado River within GCNP. Failure to detect nesting cuckoos does not indicate definitively that the species is not present within the project area. Because the range of the species overlaps to some extent with the southwestern willow flycatcher, Conservation Measures for riparian habitats along the mainstem Colorado River and tributaries also partially extend to the western yellow-billed cuckoo.

Threats

Loss and modification of southwestern riparian habitats have occurred from urban and agricultural development, water diversion and impoundment, channelization, livestock grazing, off-road vehicle use and other recreational uses, and hydrological changes resulting from these and other land uses (USFWS 2001). Losses of riparian habitats from historic levels have been substantial in Arizona and these losses have been greatest at lower elevations (below 3,000 feet) along the lower Colorado River and its tributaries which have been strongly affected by upstream dams, flow alterations, channel modification, and clearing of land for agriculture (USFWS 2001). Another likely factor in the loss and modification of the habitat for the western yellow-billed cuckoo is the invasion by the non-native tamarisk (USFWS 2001).

Analysis and Determination of Effects

Impacts to the western yellow-billed cuckoo would be focused on the river/riparian habitat within the park which constitutes the species' potential and suitable breeding areas. As with other bird species, cuckoos may be disturbed due to increased human-generated noise during the breeding season. Fisheries management treatments have the potential for increased noise from traveling through areas to get to project sites, and nearshore project activities; however, established trails and campsites will be utilized by fisheries crews, and therefore, impacts would not be measureable above current conditions. Proposed activities are water based but could impact some shoreline vegetation (trampling) and cause some noise disturbance. NPS has determined the proposed action ***may impact individuals but is not likely to result in a trend toward federal listing***.

Critical Habitat and Determination of Effects

Critical habitat has not been designated for the western yellow-billed cuckoo.

Conservation Measures

- As funding allows, GCNP would conduct surveys for the western yellow-billed cuckoo. Such surveys may be combined with surveys for breeding birds and/or southwestern willow flycatchers. Surveys should be conducted once every 3 years for the life of the CFMP.
- Occupied western yellow-billed cuckoo habitat would be avoided during the breeding season (June 1 – August 31)

- Prior to the start of any fisheries management activities, GCNP's wildlife department would be contacted for any new information related to cuckoos, cuckoo habitat, and their status near the project area.
- Habitat modification of riparian areas would not occur as part of fisheries management activities

9.0 GENERAL CONSERVATION AND MITIGATION MEASURES

- To reduce noise, mechanized equipment would not be used any longer than is necessary
- Efforts would be made to minimize the number of trips and to reduce the visibility, duration, and sounds of fisheries management work outside of visitor use areas
- Fisheries biologists would ensure that all NPS and GCNP rules, regulations and Standard Operating Procedures are followed
- Crews would be informed of special status species locations before implementing project activities
- Crews would practice low impact field techniques and Leave No Trace to the extent possible
- Grand Canyon's Parkwide Spill Response Plan will be utilized by park employees and contractors to prevent potential poisoning of wildlife, as well as soil and water contamination. Project Leaders are responsible for signing and implementing this plan.

10.0 CONCLUSION AND REQUEST FOR CONCURRRENCE

The submission of this Biological Assessment to the USFWS constitutes our request for concurrence on The Comprehensive Fisheries Management Plan for GCNP and GLNRA with the following determinations:

Humpback chub - *may affect, and is likely to adversely affect; likely to beneficially affect*

Razorback sucker - *may affect, and is likely to adversely affect; likely to beneficially affect*

California condor – *may affect, not likely to adversely affect*

Mexican spotted owl – *may affect, not likely to adversely affect*

Southwestern willow flycatcher – *may affect, not likely to adversely affect*

Yuma clapper rail - *may affect, not likely to adversely affect*

Western yellow-billed cuckoo – *may impact individuals but is not likely to result in a trend toward federal listing*

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APPENDIX A

FIGURES

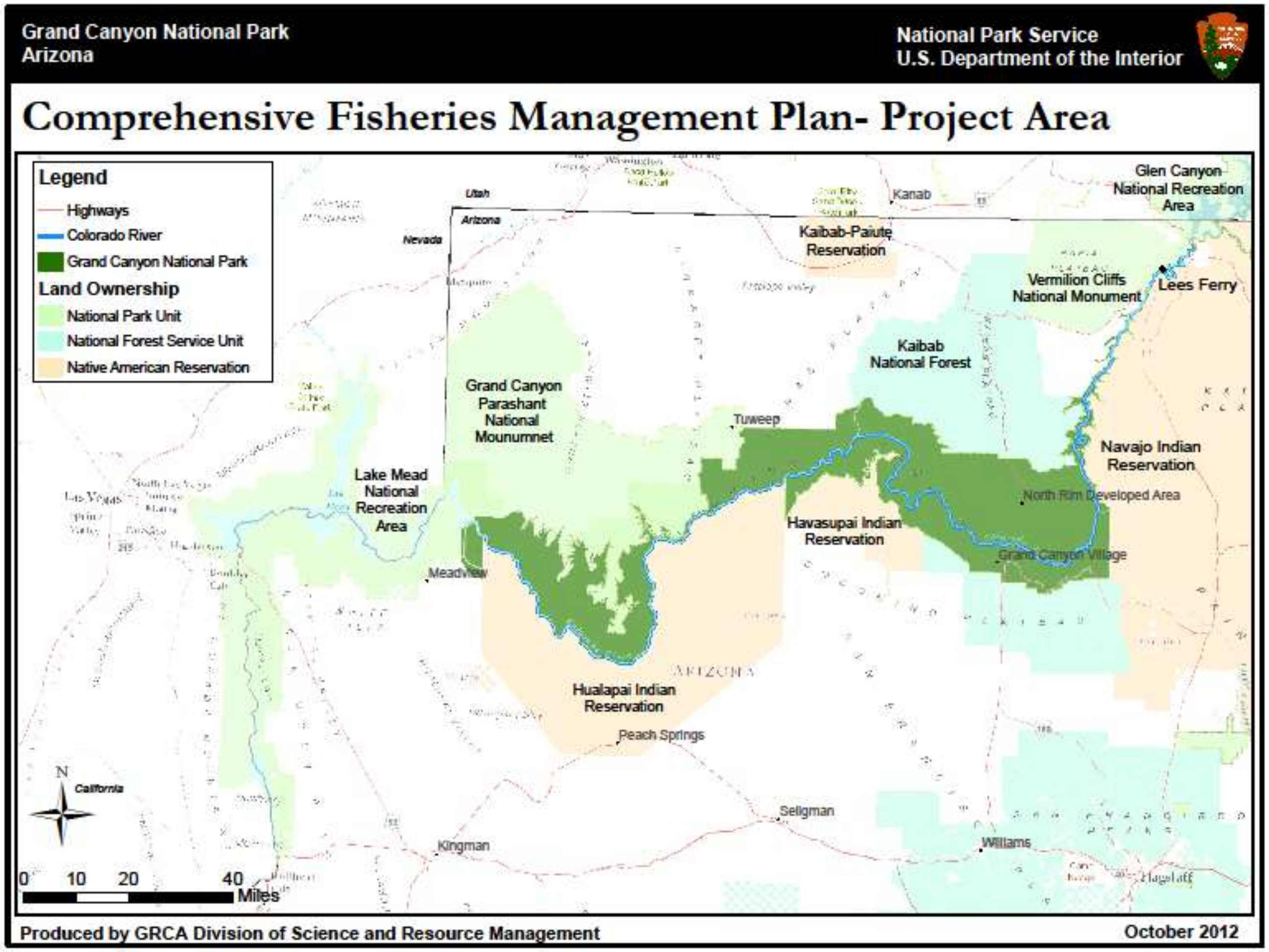

Figure 1. Project Area and Region. The project area includes the Colorado River and its tributaries in GLCA and GRCA between Glen Canyon Dam and the GRCA/Lake Mead National Recreation Area Boundary.

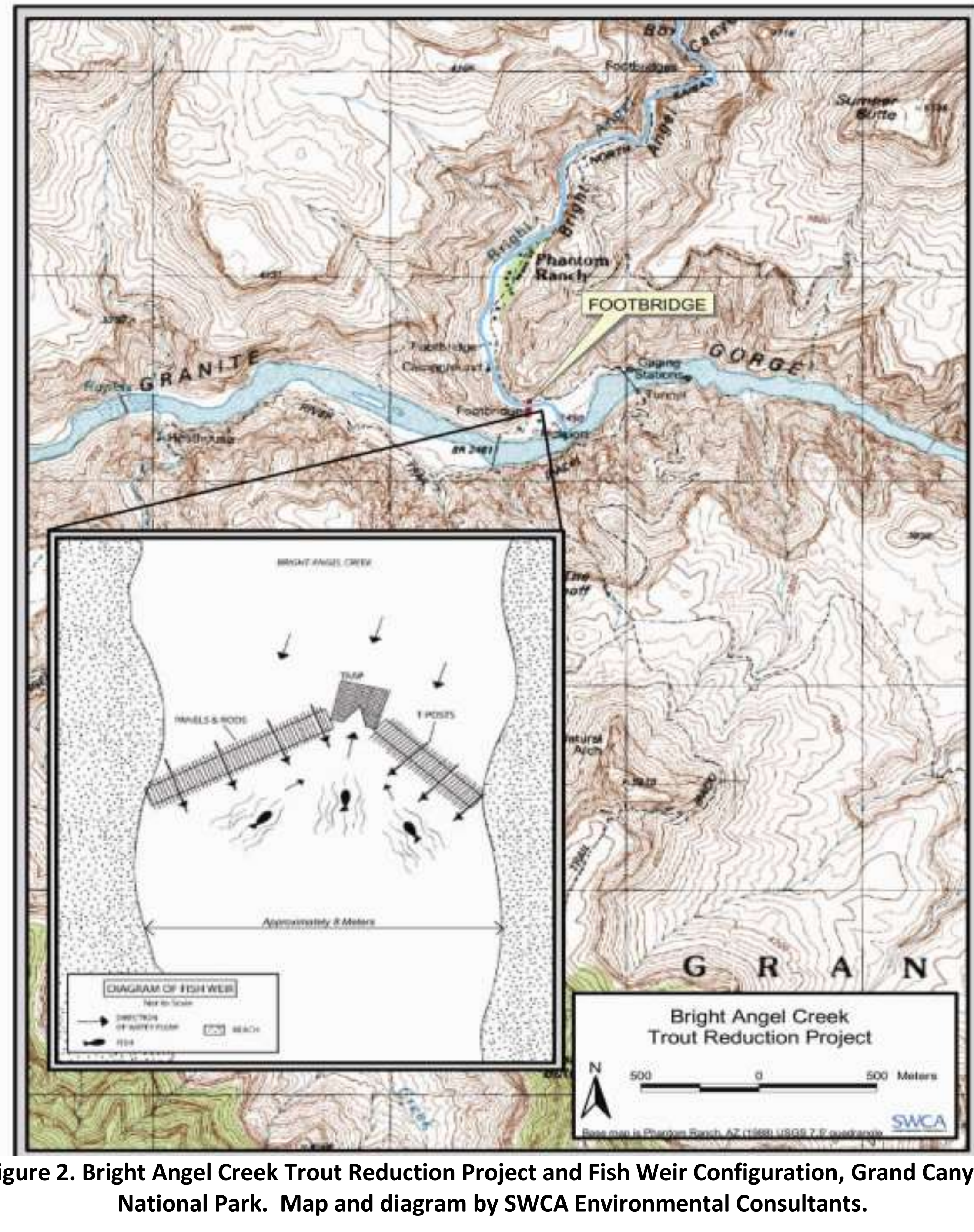

Figure 2. Bright Angel Creek Trout Reduction Project and Fish Weir Configuration, Grand Canyon National Park. Map and diagram by SWCA Environmental Consultants.

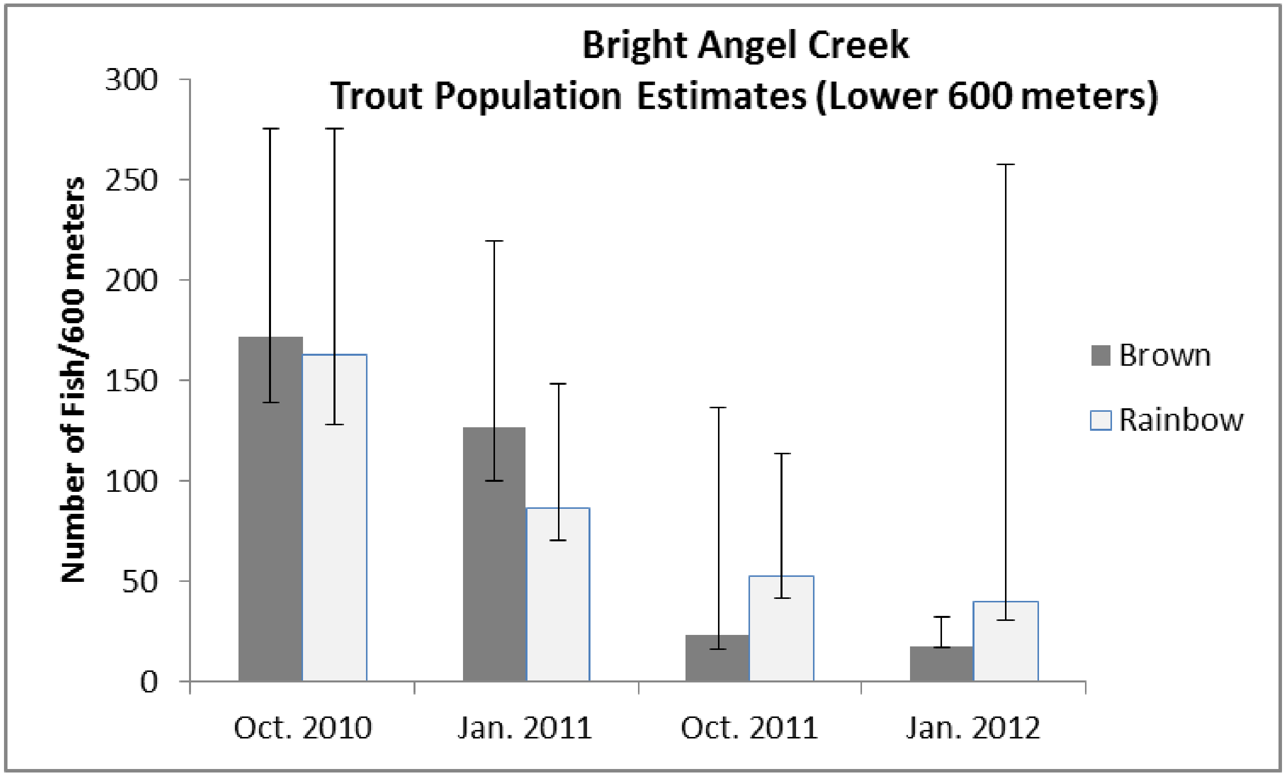

Figure 3. Bright Angel Creek trout population estimates for the lower 600 meters of the creek, October 2010 to January 2012.

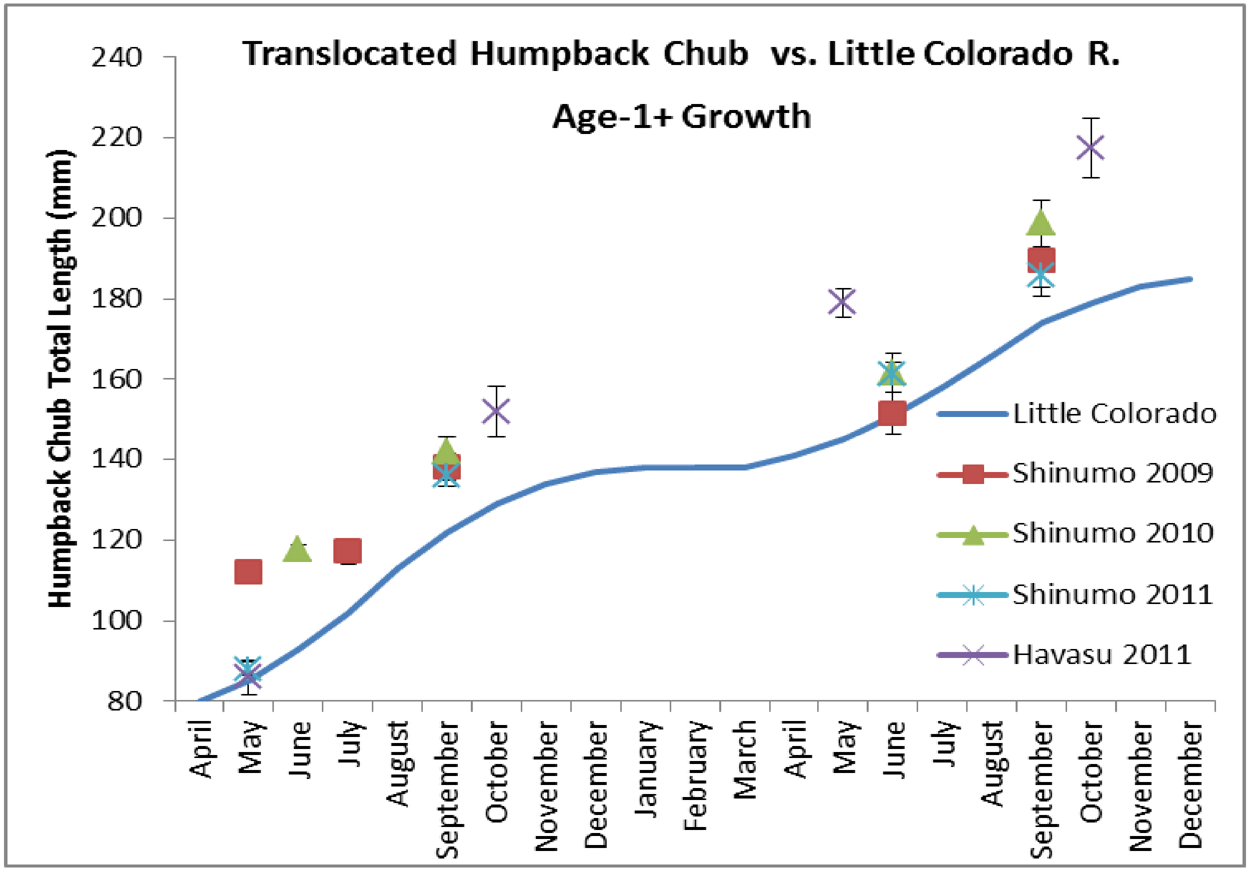

Figure 4. Average total length (mm) of humpback chub, by translocation cohort, at release (May or June) and at recapture during each monitoring trip in Shinumo and Havasu creeks, compared to average length by age (month) in the LCR as indicated by the growth curve (blue line) developed by Robinson and Childs (2001). Error bars indicate 95% confidence intervals.

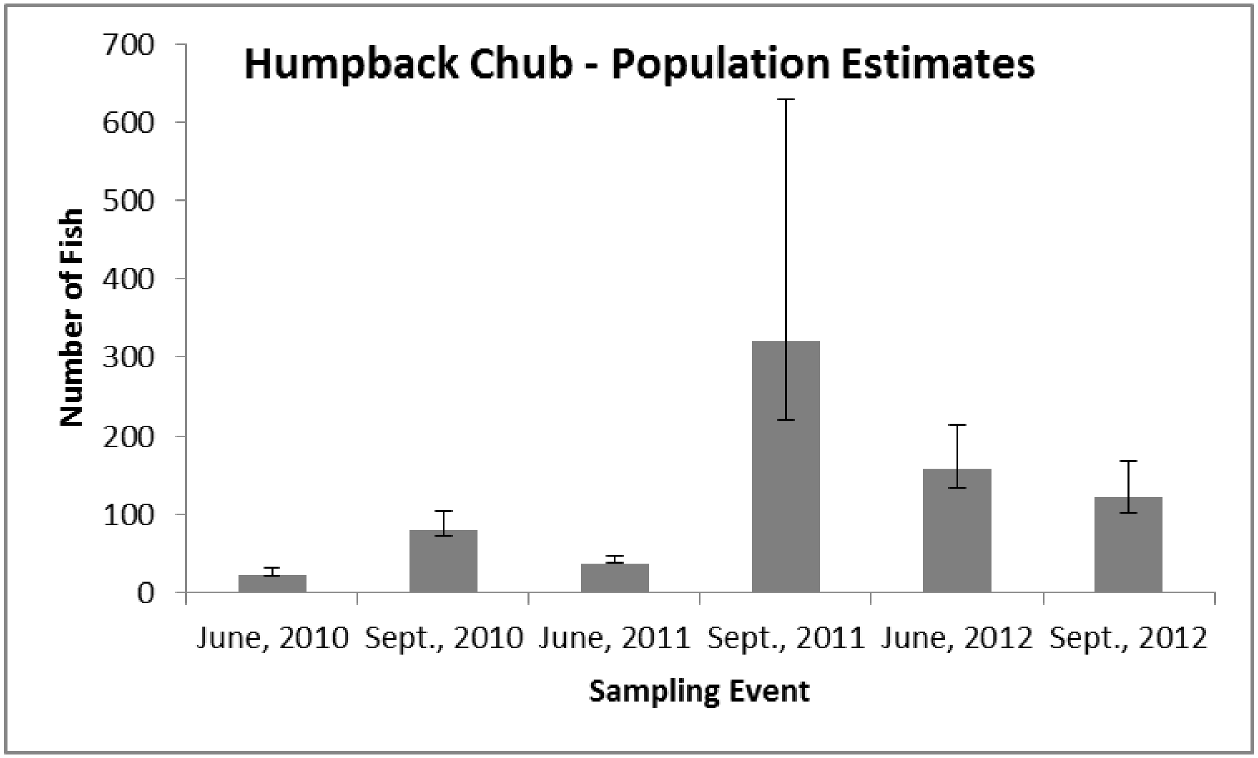

Figure 5. Population of humpback chub translocated to Shinumo Creek, June 2010 through September 2012.

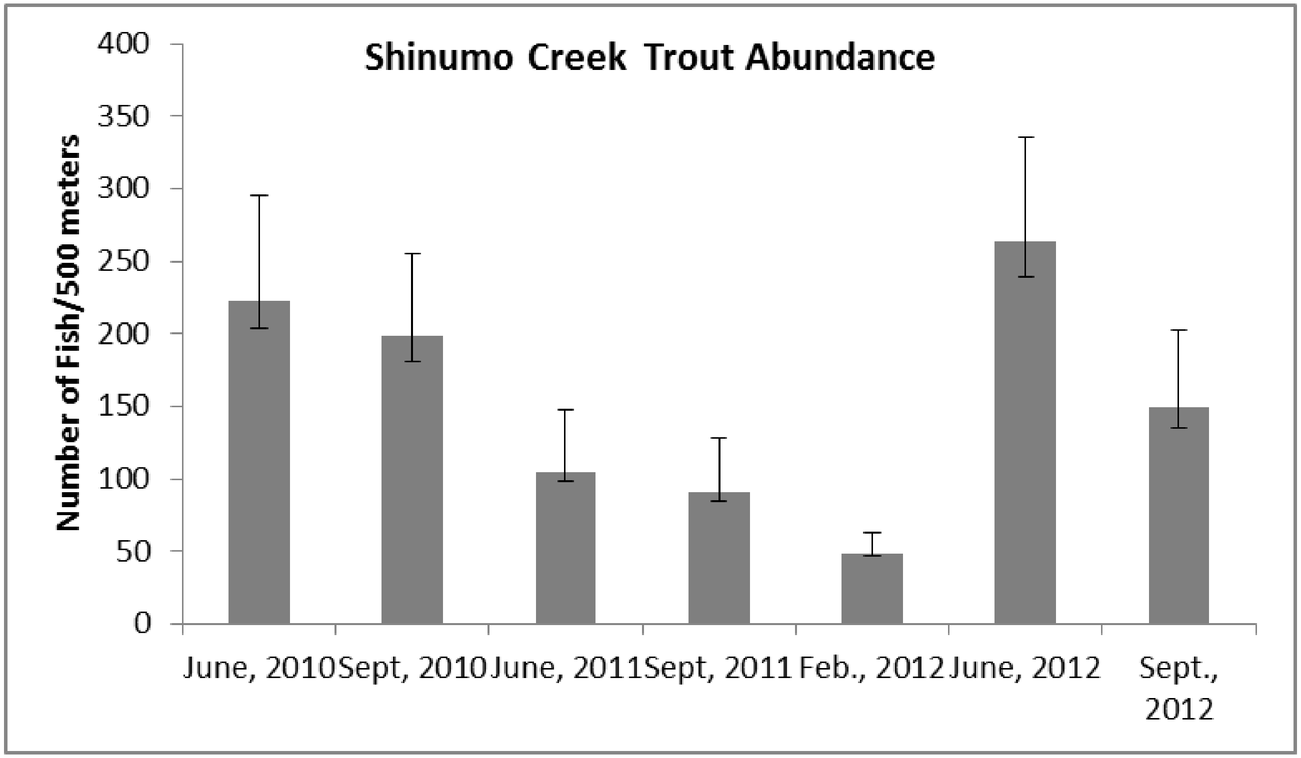

Figure 6. Shinumo Creek rainbow trout abundance based on depletion analysis, June 2010 through September 2012. Note: No trout abundance data are available for 2009.

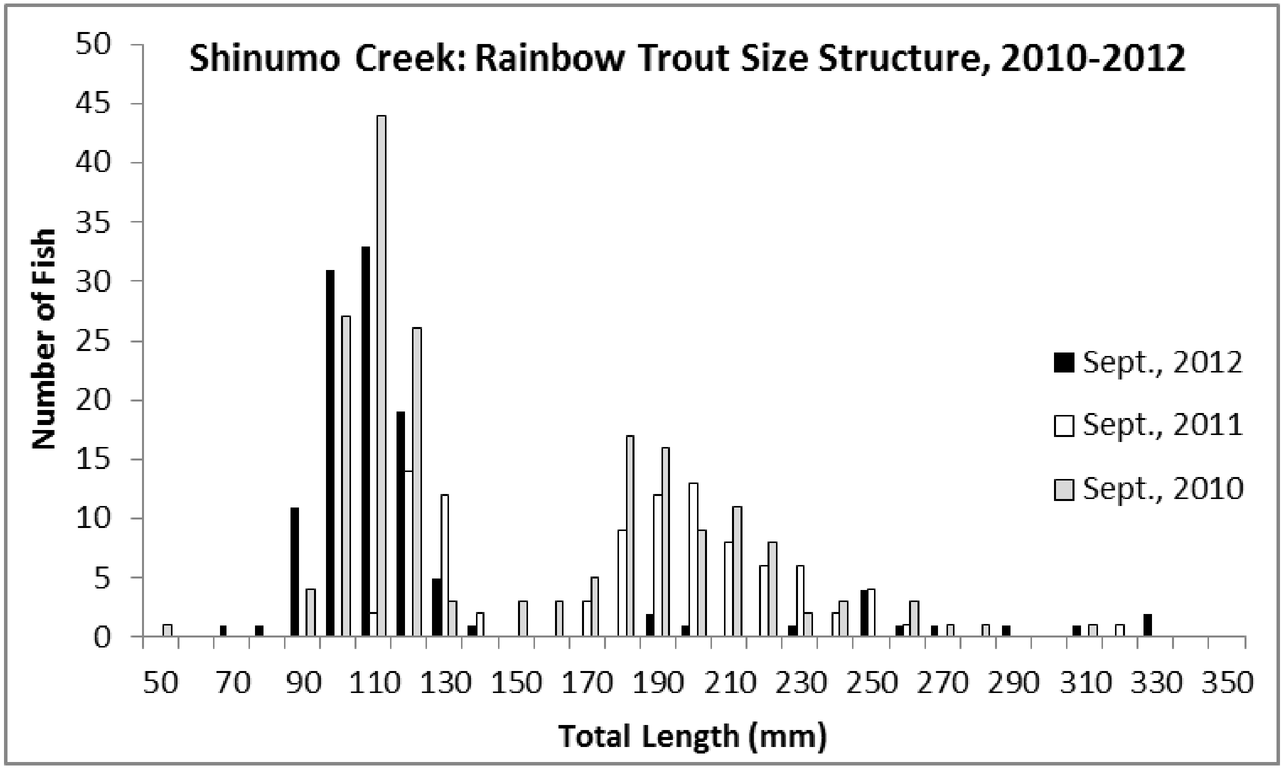

Figure 7. Shinumo Creek rainbow trout population size structure, September 2010 through 2012.

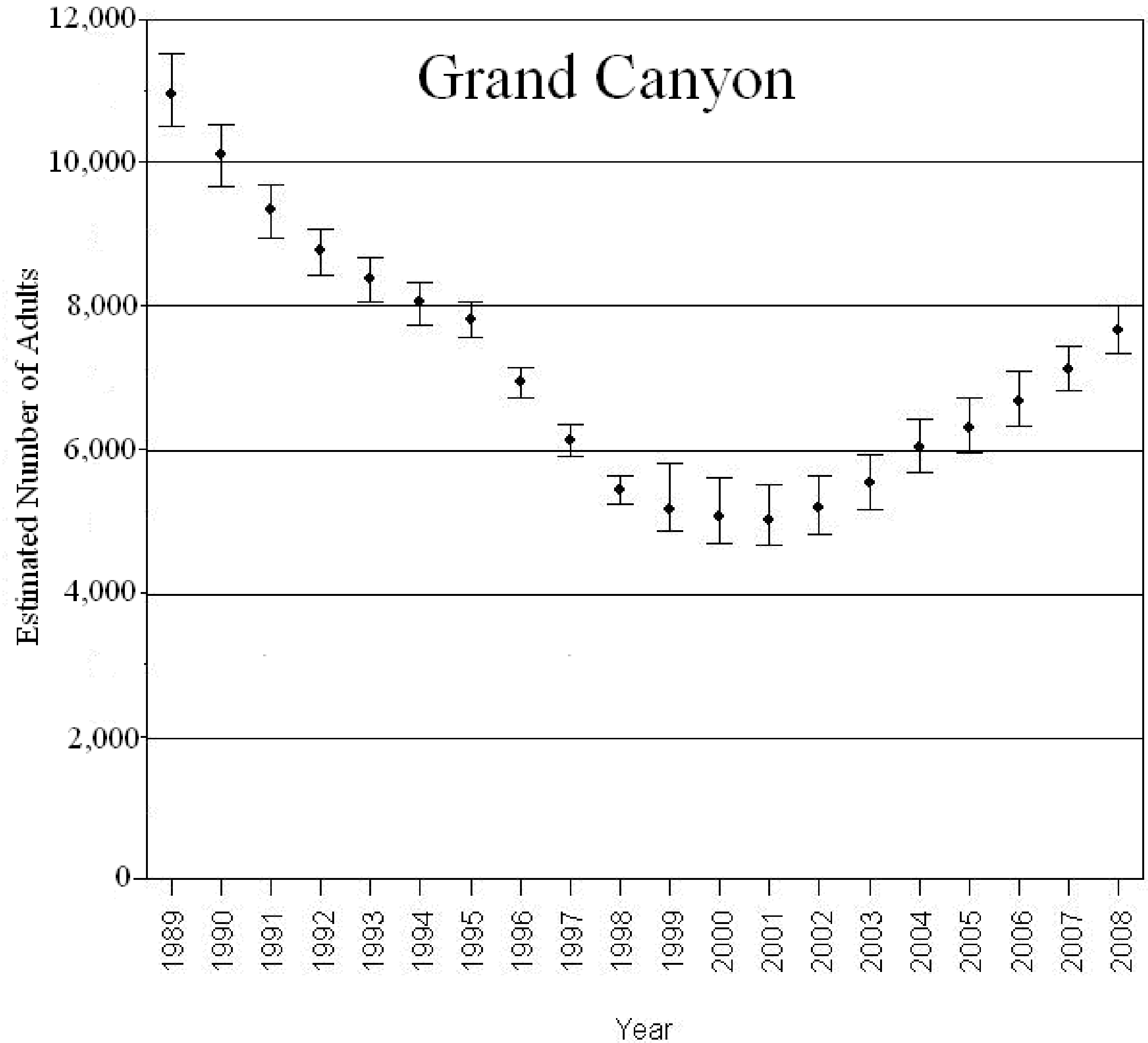

Figure 8. From the 5-year Review of Humpback Chub (USFWS 2011b), estimated numbers of humpback chub adults (≥ 200-mm TL) in the GCNP population of the Colorado River (USFWS 2011a). Error bars are a range of estimates from Monte Carlo simulations (Coggins and Walters 2009)

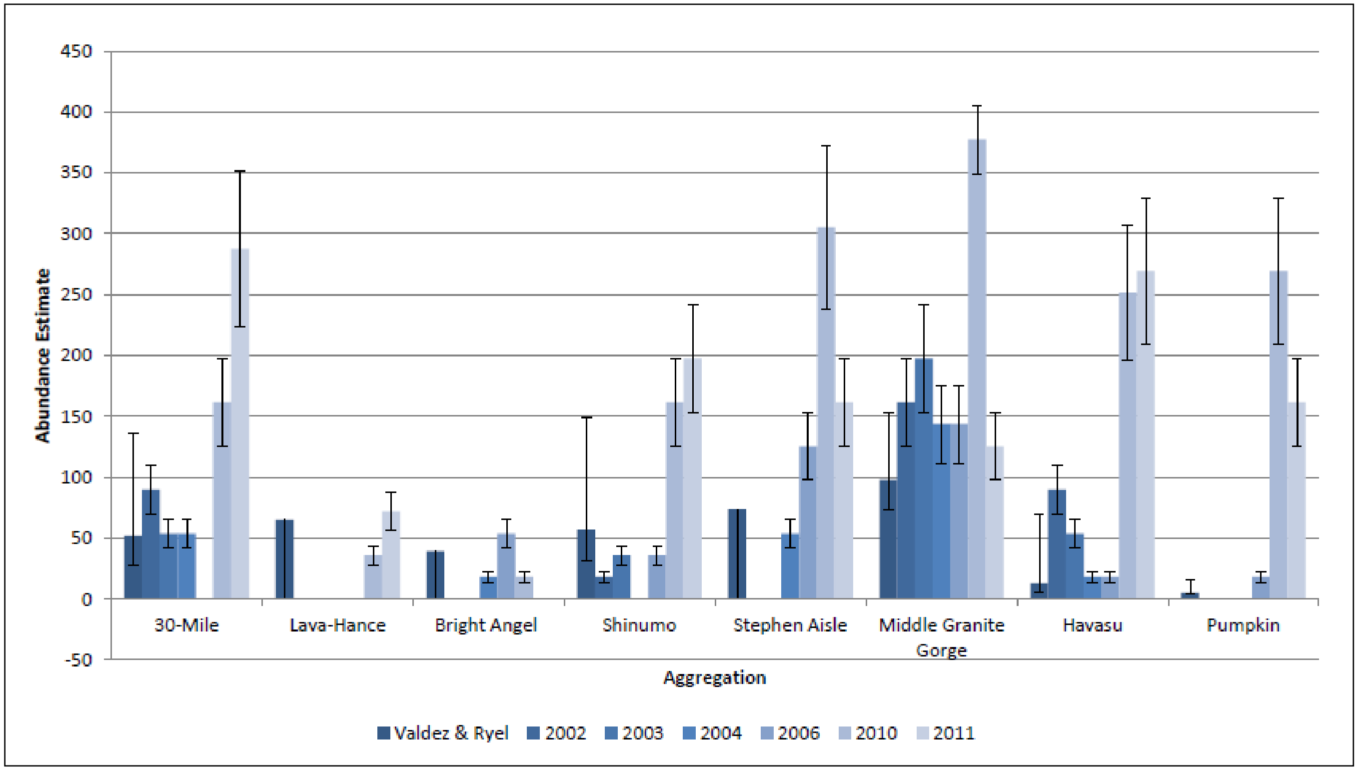

Figure 9. Preliminary closed population estimates using pooled capture probability for Grand Canyon humpback chub aggregations outside of the LCR for 2010 and 2011 (figure and data source: W. Persons and R. VanHaverbeke, 2012, presentation to the Desert Fishes Council), compared to historic data.

[redacted]

Figure 10. California condor nest locations within Grand Canyon National Park, Arizona, 2001-2012.

[redacted]

Figure 11. Mexican spotted owl critical habitat and protected activity centers, Grand Canyon National Park, Arizona.

[redacted]

Figure 12. Southwestern willow flycatcher detections and nest sites, Grand Canyon National Park, Arizona, 1982-2012.

APPENDIX B

COMPLETE LISTING OF SPECIAL STATUS SPECIES WITHIN GRAND CANYON NATIONAL PARK, ARIZONA

Common Name	Scientific Name	Status			
		Federal	State	Navajo**	Other
Wildlife					
Invertebrates					
Grand Canyon cave pseudoscorpion	*Archeolarca cavicola*	-	-	-	SC
Kanab ambersnail	*Oxyloma haydeni kanabensis*	E	-	-	EN2
Niobrara ambersnail	*Oxyloma haydeni*, closely related to *Oxyloma haydeni kanabensis*	-	WSC	-	SC
Fish					
Flannelmouth sucker	*Catostomus latipinnis*	-	-	-	SC
Humpback chub	*Gila cypha*	E	WSC	G2	
Razorback sucker	*Xyrauchen texanus*	E	WSC	G2	
Amphibians					
Lowland leopard frog	*Rana yavapaiensis*	-	WSC	-	-
Northern leopard frog	*Rana pipiens*	-	WSC	G2	
Relict leopard frog	*Rana onca*	C	WSC	-	-
Reptiles					
Desert tortoise (Mojave population)	*Gopherus agassizii*	T	WSC	-	-
Desert tortoise (Sonoran population)	*Gopherus agassizii*	-	WSC	-	SC
Birds					
American peregrine falcon	*Falco peregrinus anatum*	D	WSC	-	SC
Bald eagle	*Haliaeetus leucocephalus*	D	WSC	-	
California brown pelican	*Pelecanus occidentalis californicus*	D	-	-	
California condor	*Gymnogyps californianus*	E,XN	WSC	-	
Mexican spotted owl	*Strix occidentalis lucida*	T	WSC	G3	
Northern goshawk	*Accipiter gentilis*	-	WS C	-	-
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	WSC	G2	
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	C	WSC	G3	
Yuma clapper rail	*Rallus longirostris yumanensis*	E	WSC	-	
Mammals					
Allen's lappet-browed bat	*Idionycteris phyllotis*	-	-	-	SC
Desert bighorn sheep	*Ovis canadensis mexicana*	-	-	G3	
Greater western mastiff bat	*Eumops perotis californicus*	-	-	-	SC
Long-legged myotis bat	*Myotis volans*	-	-	-	SC
Mexican long-tongued bat	*Choeronycteris mexicana*	-	WSC	-	SC
Pale Townsend's big-eared bat	*Corynorhinus townsendii*	-	-	-	SC
Pocketed free-tailed bat	*Nyctinomops femorosacca*	-	-	-	SC
Southwest river otter	*Lontra canadensis sonora*	-	WSC	G1	SC
Southwestern myotis bat	*Myotis auriculus*	-	-	-	SC
Spotted bat	*Euderma maculatum*	-	WSC	-	SC
Western red bat	*Lasiurus blossevillii*	-	WSC	-	
Plants					
Arizona rubberweed	*Hymenoxys subintegra*	-	-	-	SC,EN2
Brittlebush	*Encelia resinifera* ssp. *tenuifolia*	-	-	-	SC,EN1
Bunchflower evening primrose	*Camissonia confertiflora*	-	-	-	SC,EN1
California bearpoppy	*Arctomecon californica*	-	SR	-	SC,EN2
Deer goldenbush	*Ericameria arizonica*	-	-	-	SC,EN1
Deer goldenbush	*Ericameria cervina*	-	-	-	SC,EN2
Flagstaff rockcress	*Arabis gracilipes* (genus name is changing to *Boechera*, not in ITIS yet)	-	-	-	SC,EN2
Grand Canyon agave	*Agave phillipsiana*	-	SR	-	SC,EN2
Grand Canyon beavertail cactus	*Opuntia basilaris* var. *longiareolata*	-	SR	-	EN2
Grand Canyon cave-dwelling primrose	*Primula specuicola*	-	SR	-	SC,EN2
Grand Canyon glowweed	*Hesperodoria scopulina* var. *scopulina*	-	-	-	EN2
Grand Canyon rose	*Rosa stellata* ssp. *abyssa*	-	-	-	SC,EN2
Kaibab agave	*Agave utahensis* ssp. *kaibabensis*	-	SR	-	EN2
Kaibab paintbrush	*Castilleja kaibabensis*	-	-	-	SC,EN2
Kaibab Plateau beardtongue	*Penstemon pseudoputus*	-	-	-	SC,EN2
Kaibab suncup	*Camissonia specuicola* ssp. *specuicola*	-	-	-	SC,EN2
Kaibab suncup (Grand Canyon evening-primrose)	*Camissonia specuicola* ssp. *hesperia*	-	-	-	SC,EN2
Kaibab whitlowgrass	*Draba asprella* var. *kaibabensis*	-	-	-	SC,EN2

Kearney's mustard	*Thelypodiopsis purpusii*	-	-	-	SC
Macdougal Indian parsley	*Aletes macdougalii* ssp. *macdougalii*	-	-	-	EN2
McDougall's yellowtops	*Flaveria mcdougallii*	-	SR	-	SC,EN1
Mt. Dellenbaugh sandwort	*Arenaria aberrans*	-	-	-	EN2
Narrow scorpionweed	*Phacelia filiformis*	-	-	-	SC,EN2
Newberry's yucca	*Hesperoyucca newberryi*	-	SR	-	EN2
Pillar false gumweed	*Vanclevea stylosa*	-	-	-	EN2
Roaring Springs prickle poppy	*Argemone arizonica*	-	-	-	SC,EN1
Rough whitlowgrass	*Draba asprella* var. *stelligera*	-	-	-	SC,EN2
Sentry milk-vetch	*Astragalus cremnophylax* var. *cremnophylax*	E	-	-	EN1
North Rim milk-vetch	*Astragalus septentriorema*	-	-	-	SC,EN1
Spiked ipomopsis	*Ipomopsis spicata* ssp. *tridactyla*	-	-	-	SC,EN1
Straightbranched catchfly	*Silene rectiramea*	-	-	-	SC,EN1
Tusayan flameflower	*Phemeranthus validulus* (syn. *Talinum validulum*)	-	-	-	SC,EN2
Willow glowweed	*Hesperodoria salicina*	-	-	-	SC,EN2
Marble Canyon spurge	*Euphorbia aaron-rossii*	-	-	-	SC,EN2

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50 CFR 17.11 – 17.12
Fish and Wildlife Service, Endangered Species Program. Available at: www.fws.gov/endangered
Arizona Game and Fish Department Heritage Data Management System. Available at: http://www.azgfd.gov/w_c/edits/species_concern.shtml
Brian, Nancy J. 2000. A Field Guide to the Special Status Plants of Grand Canyon National Park Science Center, Grand Canyon National Park. Grand Canyon, Arizona.
Species names conform to the Integrated Taxonomic Information System (IT IS). Available at: www.itis.gov

Federal Status:

E Endangered, in danger of extinction
T Threatened, severely depleted
C Candidate for listing as threatened or endangered
XN Experimental, non-essential population; in Grand Canyon condors are managed as federally threatened
D Delisted

State Status:

WSC Wildlife of Special Concern in America
E Endangered, state listing
SR Listed as salvage restricted by the Arizona Department of Agriculture; the plant is subject to damage by theft or vandalism; a state permit and salvage fees required for removal

Navajo Endangered Species List

Group 1 (G1) No longer occurs on Navajo Nation lands, Arizona Game and Fish Department, 1996
Group 2 (G2) Prospect of survival or recruitment is in jeopardy
Group 3 (G3) Prospect of survival or recruitment is likely to be in jeopardy in the foreseeable future
"Navajo status determination is not used by any other affiliated Grand Canyon tribes

Other

H Known to occur on Hualapai Reservation; not currently documented within GRCA boundary
SC Species of Concern. Some information showing vulnerability or threat, but not enough to support listing under the Endangered Species of Concern. Some of these species are former USFWS Category 1, 2, and 3 species (Note: the Southwest Region of the USFWS no longer maintains a list of Category 1, 2, or 3 species)
EN1 Endemic to GRCA. These species are only known to occur in GRCA, populations and trends should be monitored
EN2 Endemic to the GRCA region, including known populations outside of park boundaries, but very limited in overall distribution
U Habitat not likely to be found in GRCA, but occurs outside park in northern Arizona

APPENDIX C

PAST, CURRENT, AND FUTURE SAMPLING EFFORTS BY AGENCY WITHIN THE PROJECT AREA

Agency	**Project**	2012	2013	CFMP (proposed)/ Typical
	Lees Ferry/GCNRA			
GCMRC/AZGFD	Lees Ferry trout population monitoring (electro-fishing)	3	3	3
GCMRC/AZGFD	Rainbow trout tagging (natal origins-electro-fishing)	2	2	2
GCMRC	Natal Origins-Rainbow trout (electrofishing/netting)	3	4	3
GCMRC	Lees Ferry trout early life stage monitoring (electro-fishing)	3	3	3
	Little Colorado River			
GCMRC/USFWS	Humpback Chub Population Monitoring on the Little Colorado River (netting)	4	4	4
GCMRC/USFWS	Monitoring/translocation of HBC above Chute Falls on the LCR (netting)	3	3	3
GCMRC/USFWS	LCR Juvenile Humpback chub monitoring (netting)	0	1	1
USFWS/NPS/GCMRC	LCR collection/Chute Falls translocation (netting)	1	1	1
	Mainstem Colorado River (Grand Canyon)			
GCMRC	Natal Origins/Juvenile HBC monitoring (electro-fishing and netting)	3	4	4
GCMRC/USFWS/AZGFD	Mainstem Collaborative Fish Monitoring (electro-fishing)	2	3	2
GCMRC/USFWS/AZGFD	Maintem Aggregation Sampling (netting)	1	2	2
NPS	Shinumo Inflow Aggregation Monitoring (netting)	1	2	2
NPS/AZGFD	Marble Canyon angling-trout removal (angling)	0	0	2 to 4
NPS	Razorback Sonic telemetry/Lower GCNP NNF monitoring (seining)	0	0	6
	Tributaries outside the Little Colorado River			
NPS	Shinumo Creek monitoring: HBC/fish community (electrofishing -2 trips, netting only in June)	3	3	3
NPS	Havasu Creek monitoring HBC and fish community (netting)	2	2	2
NPS	Kanab Creek non-native species surveillance (netting/electrofishing)	0	0	2
NPS	Bright Angel Creek tributary NNF removal/electrofishing	1	1	1
NPS	Bright Angel Inflow NNF removal/electrofishing	0	0	1
	Total	32	38	45

Future sampling and monitoring trips proposed in 2012 are listed, as well as a possible typical future schedule under the preferred alternative. This list does not include potential emergency response trips that would occur if new or expanded populations of high risk non-native fish were found.

APPENDIX D

SOUTHWESTERN WILLOW FLYCATCHER HISTORIC AND RECENT TERRITORIES AND NESTING SITES, GRAND CANYON NATIONAL PARK, ARIZONA

[redacted]

[redacted]

APPENDIX E

YUMA CLAPPER RAIL HISTORIC RECORDS AT GRAND CANYON NATIONAL PARK, ARIZONA

River Mile/Location	Year	Notes
[redacted]	1996	one rail; nesting confirmed
[redacted]	1997	one rail; nesting not confirmed
[redacted]	1999	one male observed
[redacted]	2000	one female observed
[redacted]	2001	three individuals detected