United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 FAX: (602) 242-2513

In Reply Refer To:
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August 20, 2013

Memorandum

To: Superintendent, Grand Canyon National Park, National Park Service, Grand Canyon, Arizona

Superintendent, Glen Canyon National Recreation Area, National Park Service, Page, Arizona

From: Field Supervisor

Subject: Final Biological Opinion on the Comprehensive Fisheries Management Plan, Coconino and Mohave Counties, Arizona

Thank you for your request for formal consultation with the U.S. Fish and Wildlife Service (USFWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (ESA). Your May, 2013 request and Biological Assessment (BA) were received by us on May 10. At issue are impacts that may result from the implementation of the proposed Comprehensive Fisheries Management Plan (CFMP) for native and non-native fish management by the National Park Service (NPS) in Grand Canyon National Park (GRCA) and the portion of Glen Canyon National Recreation Area (GLCA) below Glen Canyon Dam in Coconino and Mohave counties, Arizona.

In the BA, NPS concluded that the proposed action "may affect, and is likely to adversely affect" the endangered humpback chub (*Gila cypha*) and its critical habitat, and the endangered razorback sucker (*Xyrauchen texanus*) and its critical habitat. You also concluded that the proposed action "may affect, but is not likely to adversely affect" the threatened Mexican spotted owl (*Strix occidentalis lucida*) and its designated critical habitat, the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), the endangered Yuma clapper rail (*Rallus longirostris yumanensis*), the experimental non-essential population of the California condor (*Gymnogyps californianus*)[1] and the candidate western yellow-billed cuckoo (*Coccyzus americanus*). We concur with your determinations for the five bird species and provide our rationales in Appendix A.

[1] The California condor is considered as a threatened species in National Parks within the 10j population area.

This biological opinion (BO) covers only actions by GRCA and GLCA staff, other NPS staff, contractors, and volunteers or other individuals working under NPS control to implement the activities contained in the proposed action for the humpback chub and razorback sucker in the action area. The action area is the Colorado River and its tributaries within GRCA and GLCA from Glen Canyon Dam to the GRCA boundary with the Lake Mead National Recreation Area (LAKE), which is a unit of the NPS at approximately River Mile (RM) 277). While there are likely to be continuing cooperative efforts between LAKE and GRCA staff that address native and nonnative fish issues in the vicinity of their shared boundary, the scope of the CFMP is within the boundaries of GLCA and GRCA as described in the BA and referenced in this BO. Further, staffs from the USFWS, Bureau of Reclamation (Reclamation), U.S. Geological Survey (USGS), other NPS units, and contractors are involved with other native and nonnative fish activities within the action area and these efforts are coordinated among the agencies and contractors. Actions taken for humpback chub and razorback sucker by individuals other than NPS staff or NPS contractors, volunteers, or other individuals under NPS control are not covered by this BO. Those agencies and contractors have separate ESA and National Environmental Policy Act (NEPA) compliance and section 10(a)(1)(a) permits from the USFWS to address their activities. Those activities are included as part of the environmental baseline.

This BO is based on information provided in NPS's final BA dated May, 2013, telephone conversations and meetings between our staff, and other sources of information found in the administrative record supporting this BO. Literature cited in this BO is not a complete bibliography of all literature available on the species of concern or the effects of activities within the proposed action. A complete administrative record of this consultation is on file at this office. The proposed action is the implementation of the CFMP over the next 20 years.

The USFWS released a comprehensive BO on December 23, 2011 addressing the rangewide and action area status of the humpback chub and razorback sucker and their designated critical habitat for the implementation of Reclamation's High Flow Experiment (HFE) protocol and Non-Native Fish Control (NNFC) activities (USFWS 2011a). This BO contained extensive information on the status of both species range-wide and within the action area, ongoing biological research and monitoring associated with the Glen Canyon Dam Adaptive Management Program (GCDAMP) through the Adaptive Management Work Group (AMWG) and the USGS' Grand Canyon Monitoring and Research Center (GCMRC). The action area for the 2011 biological opinion is the same as for this biological opinion. In the interest of brevity, the USFWS incorporates by reference the range-wide and most of the action area status information on the humpback chub and razorback sucker contained in the December 23, 2011 BO, and include in this BO summaries of the action area status and any new information developed since the issuance of the December 23, 2011 BO that is relevant to evaluating the effects of the proposed action. Where inclusion of more detailed information from the December 23, 2011 BO will assist with the analysis of effects of the action under consultation in this BO, that additional information is provided herein.

CONSULTATION HISTORY

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, Arizona Game and Fish Department (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 to discuss and finalize alternatives for the plan

October 1, 17, and 19, 2012 — NPS and USFWS exchanged emails discussing the list of species for the consultation

December 14, 2012 — NPS provided preliminary draft BA for USFWS review

December 26, 2012 — USFWS provided comments to NPS on preliminary BA via email

May 10, 2013 — NPS requested formal consultation with USFWS

May 15, 2013 — USFWS acknowledged the initiation of formal consultation via memorandum to NPS

June 27, 2013 — USFWS provided draft BO to NPS for review

July 22, 2013 — NPS provided comments on the draft BO back to USFWS

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The CFMP is intended to guide NPS actions over the next 20 years to meet desired conditions for native and non-native fish resources in GLCA and GRCA. The proposed action is built off a set of goals and project-wide and reach-specific objectives to include a set of ongoing and new actions to address fishery resources. The proposed action is fully described in the May, 2013 BA (NPS 2013) provided with the request for consultation and that information is summarized into the description provided below.

While the overall goal of the CFMP is to improve the status of native fish species in the action area, it is the implementation of the management activities of the CFMP that have the potential to result in adverse effects to humpback chub and razorback sucker that are the focus of this BO. Effects to listed fish will come from capture and handling of individual fish while implementing the management activities. Currently, NPS has purposeful and incidental take coverage for their existing program through project specific BOs (USFWS 2006) and section 10(a)(1)(A) permits issued by the USFWS. The effects analysis contained in this BO will serve as the analysis for both purposeful take through future section 10(a)(1)(A) permits for NPS and incidental take in the incidental take statement with this BO that results from implementing the management actions described below.

There are three broad areas of interest contained in the CFMP; native fish, non-native species management, and the rainbow trout fishery at the Glen Canyon Reach (Glen Canyon Dam to Lees Ferry). Table 1 provides a brief summary of ongoing actions (current conditions) and what is included under the proposed action.

Project Description

<u>Humpback Chub and Native Fish Translocations</u>

Humpback chub translocations were included among the conservation measures in the most recent BO provided to Reclamation for the Operation of Glen Canyon Dam (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 releasing them in tributaries or downstream areas of the Colorado River within GRCA.

Other native fish, such as bluehead sucker (*Catostomus discobolus*), 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 2006a) 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 Little Colorado River (LCR) during late spring or 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). USFWS personnel are in charge of this effort and removal of the humpback chub from the LCR, their transport out of the canyon to an approved facility for rearing, and their return from the hatchery is covered by the USFWS under their own section 10(a)(1)(A) research and recovery permit. NPS personnel would be cooperators on these trips and assist in collecting humpback chub under the guidance of USFWS. Trips would be up to five days in length, consisting of up to six to eight biologists and volunteers. Equipment and staff would be flown into and out of previously established camps and landing areas via helicopter (up to four flights to/from camps from the Salt Helipad near the head of Salt Canyon). Collections would target young-of-the-year (YOY) fish using netting methods to obtain up to 2,000 YOY per year; however, some juveniles may also be collected. Because these fish are being collected for NPS to use in the translocations, we analyze the effects of this collection but do not provide purposeful or incidental take for NPS related to the collections.

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 millimeters (mm) (four inches [in] long) (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. 2013), genetic augmentation needs, and hatchery rearing capacity. Any additional future collection plans for larger numbers would be evaluated using the PV model developed by Pine et al. 2013. For example, larger numbers of larval fish (e.g. < 20-30 mm [~one in] long) may be targeted for collection in the late spring instead of the 40-80 mm (1.5-3.1 inch) individuals collected later in the summer as capture and rearing protocols are developed.

Translocation/Release of Fish
NPS will be in charge of stocking the humpback chub into the tributary streams. In late spring or early summer (the following year after collections), passive integrated transponder (PIT) tagged humpback chub would be flown from the NPS South Rim Helibase in aerated coolers to release sites (single flight). Initially (first five 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 one kilometer (km) (0.6 miles) of stream, below White Creek, to increase carrying capacity. Translocations to Shinumo and Havasu creeks would continue for at least two more years as per the genetic augmentation plan (USFWS 2010).

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 2010), initial translocations of at least 200 fish would occur to each release area for a minimum of five years, and up to 10 years (one 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 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 five 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. 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, an adaptive management approach to genetic management is taken in the CFMP. 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. 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 (one 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. Tissues for genetic analysis would be collected from all translocated fish, and each new year class found in translocated populations.

Monitoring
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 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) in the mainstem. NPS currently has two electrofishing trips in the creek itself; however, the proposed action now includes only one (in winter) for rainbow trout population monitoring. Rainbow trout removal during the summer trip will be done by angling to reduce stress on crews and fish during the hotter parts of the year. No multiple-pass electro-fishing would occur in tributaries containing resident or transient populations of bluehead or flannelmouth (*Catostomus latipinnis*) sucker or humpback chub during April, May, or June to avoid interfering with spawning periods. A previously installed, temporary fish detection system would be maintained for three 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 or Bright Angel Creek.

Hoopnets, seines, and minnow traps area used to capture native fish in Havasu and Shinumo creeks as part of post-stocking monitoring. Similar actions would be implemented in Bright Angel Creek if humpback chub are translocated there during the next 20 years.

<u>Native Fish Reintroduction, Augmentation, and Management</u>

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 (*Ptychocheilus lucius*) would be prioritized for the implementation or initiation of reintroduction feasibility studies. Potential hybridization between bonytail (*Gila elegans*), roundtail (*Gila robusta*) and humpback chub preclude the introduction of additional chub species (*Gila* ssp) where humpback chub may occur.

Razorback Sucker Augmentation and Adaptive Management – Lower Colorado River Fishery Management Zone (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 sucker 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 (Kegerries and Albrecht 2012). In addition, an untagged, ripe male was captured in the Lower Colorado River FMZ in October 2012 (Bunch et al. 2012). In coordination with the Lake Mead Razorback Sucker Workgroup, led by Reclamation under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) a management strategy for razorback sucker was developed (Valdez et al. 2012). 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 GRCA, 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 GRCA.
- 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 GRCP, 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; or
    b) Convene established workgroups (see Valdez et al. 2012) 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 GRCA.

Actions under this program include seining for larval fish, active and passive sonic-tracking of tagged razorback sucker, and other netting and electrofishing to locate razorback sucker between Lava Falls and Lake Mead. Most of this work will be done under contract with the contractors having their own section 10(a)(1)(A) permits. NPS will also need to have purposeful and incidental take for their actions working on the project.

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

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 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 GRCA or GLCA 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 GRCA or the Glen Canyon Reach of GLCA.

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 GRCA (Hayden et al. 2012). Additionally, the NPS would engage resource managers (AZGFD, USFWS, and tribes) or landowners in the watersheds immediately adjacent to GRCA and GLCA 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 section 7 consultation may be necessary if a long-term response, such as maintenance control, were essential or if fish capture methods to address the situation go beyond the levels included in this BO.

Comprehensive Brown Trout Control
NPS fisheries biologists would expand past trout reduction activities (weir and tributary electro-fishing) (NPS 2006b) 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 eight kilometers (km) (five miles [mi]) of the Colorado River near the confluence with Bright Angel Creek). 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. 20.8 km [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 GRCA, 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 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 GRCA and GLCA, 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 (*Rhinichthys osculus*) 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 GRCA and the Glen Canyon Reach of GLCA are monitored during AZGFD's Colorado River mainstem electro-fishing trips between Lees Ferry and Lake Mead, as well as during GLCA 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)

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.

<u>Glen Canyon Rainbow Trout Management</u>

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 < 150 mm [six 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 < 350 mm (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 GLCA, 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 GLCA'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.

CONSERVATION MEASURES

The proposed action contains a number of conservation measures to reduce the potential for adverse effects to humpback chub and razorback sucker from capture events (electrofishing and netting), and subsequent handling and tagging prior to their return to the water. The capture and handling protocols described below are common to all agencies engaged in fisheries work in the GRCA and GLCA (Persons et al. 2013).

Electrofishing:

- Electro-fishing gear will be set to avoid injury to native fish, and crews will be appropriately trained on the use of the equipment.
- In tributaries where humpback chub have been released, electrofishing equipment will be minimized in large-volume, deep pools where this gear is less effective in capturing fish, and where humpback chub tend to congregate.
- Block nets will be used during multiple-pass depletion electrofishing 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 electrofishing settings that effectively sample fish will be used in all cases. For example, during tributary electrofishing in Grand Canyon, a pulsed-DC at a frequency of 30-40 Hz (300-350 volts) has proven to be sufficient.
- Fish captured using electrofishing will be monitored in buckets, and gear settings would be adjusted if sufficient recovery is not observed.

- 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 16°C (60˚F). 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 GRCA's museum.
- PIT tagging of listed species will be performed by personnel trained in tagging methods and follow the guidelines for handling fish in GRCA (Persons et al. 2013).
- "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.
- During lower Grand Canyon larval and small-bodied fish surveys, fish large enough to be identified in the field (> about 20 mm [> 0.75 in]) will be examined for the presence of humpback chub. Larval/young-of-year humpback chub would be released alive to the extent possible.
- In the Little Colorado River, hoopnets will not use bait to attract fish with the exception that baited hoopnets can be used to collect larval and juvenile fish for translocations under the direction of USFWS personnel.

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.

EXISTING ESA COMPLIANCE FOR ONGOING ACTIVITIES IN THE PROPOSED ACTION

In the past, effects (including purposeful and incidental take) resulting from NPS work on humpback chub and razorback sucker was covered under the section 10(a)(1)(A) recovery permit issued by the FWS to GRCA and biological opinions for some specific projects (USFWS 2006). GRCA has the following actions and purposeful and incidental take covered in their current section 10(a)(1)(A) permit:

Razorback sucker

1. Authorized for scientific research and recovery purposes to conduct presence/absence surveys for razorback sucker in the Colorado River through Lower Grand Canyon and Lake Mead. (no gear type is specified)

2. Incidental mortality is limited to 15 fish of any size.

3. If incidental mortalities occur, otoliths will be extracted and preserved (if feasible) in 100% ethanol only if expertise is available to correctly extract the otoliths, otherwise the entire fish will be preserved as above and deposited in a museum.

Humpback chub

1. Authorized to conduct targeted surveys for humpback chub in the Colorado River through Grand Canyon and its tributaries using hoopnets, trapnets, and seining.

2. Nonlethal fin clipping for genetics and isotope work is authorized.

3. Targeted surveys for humpback chub using electrofishing is not authorized, nor is electrofishing authorized in areas where humpback chub have been translocated (downstream of the waterfall barrier) However, if humpback chub are encountered during electrofishing, either during nonnative fish removal efforts or during presence/absence surveys, the following criteria will be employed:

   a. In Shinumo Creek, electrofishing will only be used upstream of the waterfall barrier.
   b. At least one night of hoopnetting will occur to determine presence/absence of humpback chub in upstream areas. If more than five humpback chub are captured, no electrofishing will occur.
   c. Any humpback chub captured during electrofishing passes will be transported out of the reach and downstream of the block nets to avoid a second capture.
   d. Electrofishing will cease for that sampling event if more than 10% of translocated humpback chub are captured.
   e. Electrofishing gear will be set to avoid injury to native fish.

4. During sampling efforts, all native fish will be processed first and handling time on captured humpback chub will be minimized whenever possible.

5. If incidental mortalities occur, humpback chub otoliths will be extracted and preserved (if feasible) in 100% ethanol only if expertise is available to correctly extract the otoliths, otherwise the entire fish will be preserved as above and deposited in a museum.

6. PIT tagging of listed species will be performed by personnel trained in tagging methods and follow the guidelines for handling fish in the Grand Canyon (Persons et al. 2013).

7. Incidental take limits for humpback chub are below:
   <100mm: 40 humpback chub
   101-250 mm: 20 humpback chub
   >250 mm: 5 humpback chub

For the ongoing nonnative trout removal in Bright Angel Creek, GRCA has a biological opinion (USFWS 2006) that provides incidental take coverage for take of humpback chub in Bright Angel Creek during the trout removal efforts due to capture, handling, electrofishing, and tagging operations. The number of potential captures is unknown since humpback chub are not found in Bright Angel Creek. The potential risk comes from the presence of the humpback chub mainstem aggregation that used the confluence area of Bright Angel Creek and, on occasion, an individual humpback chub may move up into the creek and be exposed to trout removal actions. An incidental take limit of one humpback chub was included in the incidental take statement (ITS). GRCA included two conservation measures as part of the proposed action:

1. Standard fish-handling and electrofishing measures will be implemented to reduce stress and injury to fish
2. Captured humpback chub will be released upstream of the weir after scientific processing.

The reasonable and prudent measure and terms and conditions for humpback chub in the incidental take statement were:

1. All humpback chub individuals that are captured during the project will be released otherwise unharmed after scientific processing.
2. During implementation of the project, the AESO will be notified if humpback chub individuals are captured.
3. If capture and handling of humpback chub results in observed injury or death of an individual, the AESO will be notified immediately.
4. If individuals of humpback chub are captured during implementation of the project, an annual report describing the occurrence and scientific processing will be provided to the AESO by July 1 of each year.

The Bright Angel Creek BO expired in 2012 so future work on the project for non-native fish removal and humpback chub translocations is analyzed under this BO for incidental and purposeful take.

NPS also participates in projects led by GCMRC, AZGFD, Reclamation, and USFWS that involve the capture and handling of humpback chub. Of relevance to the proposed action, the acquisition and subsequent return of YOY humpback chub from the LCR for translocation purposes is currently done under the Arizona Fish and Wildlife Conservation Office of the USFWS and their section 10(a)(1)(A) permit. Rearing of the young humpback chub prior to their return to Grand Canyon is accomplished under the USFWS's Southwest Native Aquatic Research and Recovery Center (SNARRC) (formerly Dexter National Fish Hatchery and Technology Center) under their section 10(a)(1)(A) permit. Release of humpback chub back to the canyon will be the responsibility of NPS once the fish are delivered to the site by USFWS.

For the proposed action, the effects of both purposeful take and the incidental take for NPS resulting from implementation of the proposed action will be addressed in this BO. This analysis will be used to create the incidental take statement for the BO, and be used for issuance of section 10(a)(1)(A) permits for purposeful take. Appendix B contains the information on purposeful and incidental take for the proposed action.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Please refer to USFWS 2011a for more complete information on the rangewide status of humpback chub and razorback sucker including the discussion of the values of critical habitat for conservation of the species.

HUMPBACK CHUB

The humpback chub was listed as endangered on March 11, 1967 (32 FR 4001). 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 rivers in Arizona, Colorado, and Utah. Known 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 of the Colorado River for use in 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.

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 Grand Canyon, 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). Young humpback chub use shoreline talus, vegetation, and backwaters typically formed by eddy return current channels (AZGFD 1996). 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).

Valdez and Ryel (1995, 1997) reported on adult humpback chub habitat use in the Colorado River in Grand Canyon. They found that 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. Adults were found primarily in large recirculating eddies disproportionate to their availability, with lesser numbers found in runs, pools, and backwaters. Hoffnagle et al. (1999) reported that juveniles in Grand Canyon 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 radiotagged adults, with local shifts in habitat use to remain in low-velocity polygons within large recirculating eddies.

Humpback chub in Grand Canyon spawn primarily during March–May in the lower 13 km of the Little Colorado River (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). Most fish mature at about 4 years of age. Gonadal development is rapid between December and February to April, at which time somatic indices reached highest levels (Kaeding and Zimmerman 1983). Adults stage for spawning runs in large eddies near the confluence of the Little Colorado River 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). 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.

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 feet), and shift as they grow larger (75–259 mm [2.95-10.20 in] TL) by fall and winter 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 Little Colorado River, finding that humpback chub undergo an ontogenesis from diurnally active, vulnerable, nearshore-reliant y-o-y (30–90 mm [1.81-3.54 in] TL) into 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.

Movement of adult humpback chub is substantially limited compared to other native Colorado River fishes (Valdez and Ryel 1995). Adults have a high fidelity for site-specific habitats in the Colorado River and generally remain within a one km (0.6 mi) area, except during spawning ascents of the Little Colorado River 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.

The decline of the 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 Grand Canyon, 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). Valdez and Ryel (1997) also suggested that common carp 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 in the Yampa River (T. Chart, FWS, pers. comm., 2007). Parasitism, hybridization with other native *Gila*, and pesticides and pollutants are also factors in the decline (USFWS 2002a).

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 Glen Canyon Dam). 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 Yampa Canyon in Dinosaur National Monument, Colorado. The lower basin population is found in the Colorado River and tributaries in Grand Canyon. In January 2011, the FWS signed the 5-Year Review on the Humpback Chub, which describes the significant decline noted from the first adult abundance estimate to the most recent estimate for the populations in Black Rocks, Westwater Canyon, and Desolation/Gray Canyons (USFWS 2011b).. Populations in Yampa and Cataract Canyons are too small to monitor through mark-recapture analysis and some individuals have been brought into captivity to preserve their genetic uniqueness.

The Lower Basin currently hosts the largest population of humpback chub and is commonly referred to as the Grand Canyon population. 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 Grand Canyon population. These estimates indicate that the adult population declined through the 1980s and early 1990s but has been increasing for the past decade (Coggins et al. 2006a, Coggins 2008a, Coggins and Walters 2009). Coggins (2008a) summarized information on abundance and analyzed monitoring data collected since the late 1980s and found that the adult population had declined from about 8,900- 9,800 in 1989 to a low of about 4,500-5,700 in 2001, increased in 2006 to approximately 5,300-6,700, and further increased to 7,650 adults in 2008. Current methods for assessment of humpback chub abundance rely on the ASMR (Coggins et al. 2006b, 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 is increasing. They also concluded that “considering a range of assumed natural mortality-rates and magnitude of ageing error, it is unlikely that there are currently less than 6,000 adults or more than 10,000 adults” and estimate that the current adult (age 4 years or more) Grand Canyon population is approximately 7,650 fish (Coggins and Walters 2009).

Humpback Chub Critical Habitat

Critical habitat for humpback chub was designated in 1994 (59 FR 13374; March 12. 1994, USFWS 1994). Seven reaches of the Colorado River system were designated for a total river length of 379 miles in the Yampa, Green, Colorado, and Little Colorado rivers in Arizona, Colorado and Utah.

In our analysis of the effects of the action on critical habitat, we consider whether or not the proposed action will result in the destruction or adverse modification of critical habitat. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of critical habitat for the recovery of a listed species (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998). To determine this, we analyze whether the proposed action will adversely modify any of those physical or biological features that were the basis for determining the habitat to be critical. The physical or biological features that determine critical habitat are known as the primary constituent elements (PCEs). PCEs are provided by the final rule designating critical habitat and three supporting documents (USFWS 1994, Maddux et al. 1993a, 1993b. To determine if an action results in an adverse modification of critical habitat, we must also evaluate the current condition of all designated critical habitat units, and the PCEs of those units, to determine the overall ability of all designated critical habitat to support recovery. Further, the functional role of each of the critical habitat units in recovery must also be considered, because, collectively, they represent the best available scientific information as to the recovery needs of the species.

General PCEs of Critical Habitat

Critical habitat was listed for the four big river fishes (Colorado pikeminnow, humpback chub, bonytail, and razorback sucker) concurrently in 1994, and the PCEs were defined for the four species as a group (USFWS 1994). However, note that the PCEs vary somewhat for each species on the ground, particularly with regard to physical habitat, because each of the four species has different habitat preferences.

Water--Consists of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) (W1) that is delivered in sufficient quantity to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species (W2).

Physical Habitat--This includes areas of the Colorado River system that are inhabited by fish or potentially habitable for use in spawning (P1), nursery (P2), feeding (P3), or corridors between these areas (P4). In addition to river channels, these areas include bottomlands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats.

Biological Environment--Food supply (B1), predation (B2), and competition (B3) are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation, although considered a normal component of this environment, is out of balance due to introduced fish species in some areas. This is also true of competition from non-native fish species.

The PCEs are all integrally related and must be considered together. For example, the quality and quantity of water (PCEs W1 and W2) affect the food base (PCE B3) directly because changes in water chemistry, turbidity, temperature, and flow volume all affect the type and quantity of organisms that can occur in the habitat that are available for food. Likewise, river flows and the river hydrograph have a significant effect on the types of physical habitat available. Changes in flows and sediment loads caused by dams may have affected the quality of nearshore habitats utilized as nursery areas for young humpback chub. Increasingly the most significant PCE seems to be the biological environment, and in particular PCEs B2 and B3, predation and competition from non-native species. Even in systems like the Yampa River, where the water and physical PCEs are relatively unaltered, non-native species have had a devastating effect on the ability of that critical habitat unit to support conservation (Finney 2006, Fuller 2009). In fact, as we will describe in more detail, the conservation of humpback chub in the future may depend on our ability to control non-native species, and manipulating the water and physical PCEs of critical habitat to disadvantage non-natives may play an important role.

Humpback Chub Critical Habitat Reach 7 - Colorado River - Marble and Grand Canyons

The 173-mile (278.4-km) reach of critical habitat in the Colorado River in Marble and Grand Canyons extends from Nautiloid Canyon (RM 34) in T36N, R5E, section 35 (Salt and Gila River Meridian) to Granite Park (RM 208) in T30N, RI0W, section 25 (Salt and Gila River Meridian). Land ownership is 87.8 percent NPS and 12.2 percent Tribal (Navajo Nation). As discussed above, Reaches 6 and 7 constitute critical habitat occupied by the Grand Canyon population of humpback chub. While the vast majority of adult humpback chub in Grand Canyon occur in the LCR Inflow aggregation (at RM 57.0-65.4), humpback chub also occur at other aggregations in the mainstem Colorado River throughout Marble and Grand canyons, and there is some movement of humpback chub between the aggregations (Paukert et al. 2006). All nine aggregations constitute what is considered a single reproducing population (Douglas and Douglas 2007). According to Paukert et al. 2006, approximately 85% (12,508 of 14,674) of the humpback chub were captured and recaptured in the LCR, whereas only 241 (1.6%) were captured and recaptured in the mainstem Colorado River within the LCR confluence area. In 2006, concurrent estimates of the LCR and LCR inflow population were determined and represented 14,526 fish (or 99.0% of the recaptures) demonstrating the species' disproportionate reliance on the LCR. There is, however, evidence of some fish travelling among and adding to the mainstem aggregations (Paukert et al. 2006, Van Haverbeke and Persons 2011).

The eight other spawning aggregations are (per Valdez and Ryel 1995): 1) 30-mile (RM 29.8 to 31.3); 2) Lava to Hance (RM 65.7-76.3); 3) Bright Angel Creek Inflow (RM 83.8-93.2); 4) Shinumo Creek Inflow (RM 108.1-108.6); 5) Stephen Aisle (RM 114.9-120.1); 6) Middle Granite Gorge (RM 126.1-129.0); 7) Havasu Creek Inflow (RM 155.8-156.7); and 8) Pumpkin Spring (RM

212.5-213.2). Monitoring continues to confirm the persistence of these aggregations (Trammell et al. 2002), although few humpback chub have been caught at the Havasu inflow and Pumpkin Spring aggregations through 2006 (Ackerman 2008). More recent work indicates these aggregations are being maintained though most are at low numbers (USFWS 2013). Humpback chub have also been caught infrequently downstream of Pumpkin Spring (Valdez and Masslich1999). The LCR Inflow is the largest aggregation, which is in the lower 15 km (9.3 miles) of the LCR and the adjoining 15 km (9.3 miles) of the Colorado River (RM 57.0-65.4) (Valdez and Ryel 1995). The LCR aggregation has been expanded upstream of Chute Falls through translocation (Stone 2009, Van Haverbeke et al. 2011).

The abundances of the other humpback chub mainstem aggregations, other than the LCR inflow aggregation, are not precisely known, but catches of humpback chub in these other aggregations are consistently small compared to the LCR inflow aggregation. Young-of-year are consistently found throughout Grand Canyon, especially associated with aggregations at 30-mile, Middle Granite Gorge, Shinumo, and Randy’s Rock, and recruitment may be occurring at low levels given that these aggregations continue to be documented over time (Valdez and Ryel 1995, Trammel et al. 2002, Ackerman 2008). Monitoring continues to confirm the persistence of these aggregations (Trammell et al. 2002, USFWS 2013). In 2011, field surveys documented 2 or 3 year old fish in Havasu Creek just downstream of Beaver Falls (Smith et. al. 2011). Eight untagged humpback chub were captured prior to humpback chub translocation in Havasu Creek (Smith et al. 2011). Humpback chub have also been caught infrequently downstream of Pumpkin Spring (Valdez 1994), an area warmed by mineral spring flows.

Non-native fish species, most notably rainbow trout, channel catfish, brown trout, and carp, are established in the river in Marble and Grand canyons (Maddux et al. 1993b, Valdez and Ryel 1995) and prey upon and compete with native fish. Of the native fish species that historically occurred in the Grand Canyon, two have been extirpated. Extirpated species include the bonytail and Colorado pikeminnow. Reproducing populations include the humpback chub, bluehead sucker, flannelmouth sucker, and speckled dace. As discussed later in the document, the razorback sucker still occurs in the lower Grand Canyon but is very rare.

Previous consultations on humpback chub

Section 7 consultations on humpback chub have evaluated large-scale water-management activities. For the upper basin, UCRRP tracks the effects of such consultations on the species and provides conservation measures to offset the effects somewhat. Several consultations have occurred on the operations of Glen Canyon Dam, including one in 1995 that resulted in a jeopardy and adverse modification opinion. Subsequent consultations in 2008, 2009, and 2010 reached non-jeopardy/non adverse modification conclusions. In 2011, consultation was completed on the High Flow Experiment (HFE) and Non-Native Fish Control (NNFC) actions proposed by Reclamation. That BO (USFWS 2011b) also reached non-jeopardy/non-adverse modification conclusions. Finally, a consultation on Sport Fish Restoration Funding evaluated the sport fish stocking program funded by the USFWS (USFWS 2011c). Biological opinions on actions potentially affecting humpback chub in Arizona may be found at our website www.fws.gov/southwest/es/arizona in the Section 7 Biological Opinion page of the Document Library.

Razorback Sucker and its Critical Habitat

The razorback sucker was first proposed for listing under the ESA on April 24, 1978 (43 FR 17375), as a threatened species. The proposed rule was withdrawn on May 27, 1980 (45 FR 35410), due to changes to the listing process included in the 1978 amendments to the ESA. In March 1989, the FWS was petitioned by a consortium of environmental groups to list the razorback sucker as an endangered species. A positive 90-day finding on the petition was published in the Federal Register on August 15, 1989 (54 FR 33586). 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 (55 FR 21154), and the final rule published on October 23, 1991, 56 FR 54957), with an effective date of November 22, 1991. The Razorback Sucker Recovery Plan was released in 1998 (USFWS 1998). Recovery Goals were approved in 2002 (USFWS 2002b). 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 included 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 following information is a summary of life history, habitat use, current distribution, threats, and conservation actions for the razorback sucker. This information was taken from the 2002 Recovery Goals (USFWS 2002b), and the Lower Colorado River Multi-Species Conservation Program Species Status documents (LCR MSCP 2005). Information in these documents is incorporated by reference.

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 3.3 feet (1.0 m) and weigh 11 to 13 pounds (5.0 to 5.9 kilograms [km]) (Minckley 1973). Adult fish in Lake Mohave reached about half this maximum size and weight (Minckley 1983). Razorback sucker are long-lived, reaching the age of at least 40 years (McCarthy and Minckley 1987).

Adult razorback sucker use most of the available 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). Adjacent to the main channel, backwaters, oxbows, sloughs, and flooded bottomlands are also used by this species. From studies conducted in the upper Colorado River basin, habitat selection by adult razorback sucker 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. They use relatively shallow water (ca. three feet [0.9 m]) during spring and deeper water (five to six feet [1.5-1.8 m]) during winter (USFWS 2002b).

Razorback sucker 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 1998). 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 1998). 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. During higher flows, flooded bottomland and tributary mouths may provide these types of habitats.

Razorback sucker are somewhat sedentary; however, considerable movement over a year has been noted in several studies (USFWS 1998). Spawning migrations have been observed or inferred in several locales (Jordan 1891, Minckley 1973, Osmundson and Kaeding 1989, Bestgen 1990, Tyus and Karp 1990). 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 1998). In the Verde River, radio-tagged and stocked razorback sucker 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).

Since 1997, significant new information on recruitment to the wild razorback sucker population in Lake Mead has been developed (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 (Albrecht et al. 2010, Kegerries and Albrecht 2011, 2012.

The range and abundance of razorback sucker has been severely impacted by water manipulations, habitat degradation, and importation and invasion of non-native species. Construction of dams, reservoirs, and diversions destroyed, altered, and fragmented habitats needed by the sucker. Channel modifications reduced habitat diversity, and degradation of riparian and upland areas 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 sucker produce large spawns each year and produce viable young, the larvae are largely eaten by the non-native fish species (Minckley et al. 1991).

Razorback sucker Critical Habitat Reach 10: Paria River to Hoover Dam

This 365 mile (584km) reach includes the mainstem Colorado River through Marble and Grand Canyon and Lake Mead to Hoover Dam.

Available information suggests that historically, the razorback sucker was not common in the canyon-bound reaches of Marble and Grand Canyons (Minckley et al. 1991, Valdez 1996). The Recovery Goals for razorback sucker in the Lower Basin includes two self-sustaining populations (e.g., mainstem and/or tributaries) maintained over a 5-year period, but does not specify the Grand Canyon or any other specific location (USFWS 2002b). Ten records for razorback sucker were documented by 1995; one at Bright Angel Creek in 1944, one in the mainstem below the dam in 1963, a total of four in the Paria River in 1978 and 1979, one near Bass Canyon in 1986, three in

Bright Angel Creek in 1987, and three in 1989 and 1990 at the mouth of the LCR. Hybrids between razorback sucker and flannelmouth sucker have also been reported several times near the Paria River and LCR (Valdez 1996).

Razorback sucker are currently known from Lake Mead and there are records of razorback sucker collected from Gregg Basin dating from 1978-1979 (McCall 1979). Razorback sucker are recruiting in three areas of Lake Mead, most recently in 2011 (Shattuck et al. 2011). The population at the upper end of Lake Mead was re-documented in 2000-2001 through larval collections between Grand Wash Cliffs and Iceberg Canyon; although no adults were captured in net sets in 1999-2000 and 2002-2003 (Albrecht et al. 2008). AZGFD captured an adult razorback sucker in Gregg Basin in 2008 (Kegerries and Albrecht 2011). In 2010 and 2011, wild razorback sucker were captured in Gregg Basin and spawning locations were identified. These wild fish were aged at between six and 11 years old. It is unknown if these wild razorbacks are the result of recruitment at the Colorado River Inflow, or represent movements of wild razorback sucker from the known recruitment areas (two sites in the Overton Arm [the Virgin-Muddy River inflow and Echo Bay] and Las Vegas Wash) to the inflow area. In addition, nine razorback-flannelmouth sucker hybrids were captured and aged. These fish were between six and 10 years old, with four born in 2003 (Kegerries and Albrecht 2011). The radio-tagged stocked razorbacks from this study did not move upstream into Iceberg Canyon during the survey period, however, they did move between the more riverine and more lentic areas over the course of the monitoring, and were found with wild razorback sucker (Kegerries and Albrecht 2011). In 2012, three sonic-tagged razorback sucker from Lake Mead were detected by sonic sensors placed near Quartermaster Canyon (RM 260) (Kegerries and Albrecht 2012). Further, an adult male razorback sucker was captured during fish community surveys by AZGFD in October, 2012 at RM 246 (Bunch et al. 2012). These new data indicate that razorback sucker are using the Colorado River inflow area for spawning and recruitment and are moving up into the Grand Canyon at least temporarily.

Previous consultations on razorback sucker

Section 7 consultations on razorback sucker include consultations on large-scale water management activities. For the upper basin, the UCRRP addresses the effects of such consultations on the species and provides conservation measures to somewhat offset the effects of proposed actions. In the lower Colorado River, the LCR MSCP addresses effects of water management and provides conservation to offset effects of water operations. Several Statewide consultations have occurred including the Land and Resource Management Program with the Forest Service and the intra-Service consultation on Sport Fish Restoration Funding which evaluated the sport fish stocking program funded by the FWS (UFSWS 2011c). Smaller site-specific consultations addressing channelization, recreational development, and implementing recovery actions have also occurred. All prior consultations have reached non-jeopardy and non-adverse modification conclusions. Biological opinions on actions potentially affecting razorback sucker in Arizona may be found at our website www.fws.gov/southwest/es/arizona in the Section 7 Biological Opinion page of the Document Library.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Operation of Glen Canyon Dam

Physical habitat conditions (flow volume and patterns, water temperature) in the action area are controlled by how water is released from Glen Canyon Dam. The Dam has operated under modified low-fluctuating flows (MLFF) since the Record of Decision was signed in 1996. Generally, the MLFF is a set of flow constraints that results in hourly, daily, and monthly variations in flow from Glen Canyon Dam. The MLFF is implemented by Reclamation through the GCDAMP as defined in the 1995 EIS and 1996 ROD (USBR 1995, 1996). The variations in flow resulting from MLFF affect many aspects of the ecosystem from Glen Canyon Dam to Lake Mead. Effects are on the abiotic aspects of the ecosystem (e.g., water temperature, turbidity, sediment transport, riverine habitat formation) and on the biotic aspects (e.g. food base dynamics, fish species abundance and composition, fish growth, fish predation rates, prevalence of disease or parasites). Many of these effects are poorly understood, and adding to the complexity is the fact that few if any effects can be analyzed separately because they interact. In 2012, Reclamation finalized two EAs; one for the HFE Protocol (USBR 2012a) and NNFC (USBR 2012b) that allow for more frequent HFE events and addresses the potential effects of those HFEs on rainbow trout populations as they might affect humpback chub.

As a result of the several biological opinions issued for the operation of Glen Canyon Dam, Reclamation has a number of conservation measures that are implemented to address adverse effects to humpback chub and razorback sucker. Of particular relevance to the proposed action, the following conservation measures interact with components of the NPS proposed action. These are more fully described in USFWS 2008a and 2011a.

1. Humpback chub translocation and nonnative fish removal in Havasu Creek and Shinumo Creek
2. Monitoring of the humpback chub mainstem aggregations every year.
3. Bright Angel Creek brown trout control.
4. Mechanical removal of trout in the LCR reach based as required based on meeting specific conditions.
5. Test of rainbow trout removal in the Paria River/Badger Rapids reach and subsequent implementation as appropriate.
6. Study the use of “fishery management flows” to manage trout reproduction and emigration in the Lees Ferry Reach.
7. Evaluation of razorback sucker habitat and use of the lower Grand Canyon.

The status information below is condensed from the December 23, 2011 biological opinion (USFWS 2011a) and focuses on the existing conditions that have relevance to this consultation. The information on how Glen Canyon Dam operations have affected the species and their habitats is fully described in USFWS 2011a and all information from that document is incorporated by reference.

STATUS OF THE SPECIES AND CRITICAL HABITAT WITHIN THE ACTION AREA AND FACTORS AFFECTING THAT STATUS

Humpback chub

The status of the humpback chub in the action area has improved since 2000 with increasing numbers of adult fish in the LCR Reach and evidence of YOY overwintering at 30-mile (Andersen et al. 2010, Yard et al. 2011). The Grand Canyon population consists primarily of adults residing in and near the LCR (the LCR Inflow aggregation), with eight other much smaller aggregations of the species scattered throughout approximately 288 km (180 mi) of the mainstem Colorado River as described above. Successful translocation of juvenile humpback chub into Havasu and Shinumo creeks is likely to increase the status of those aggregations and improve the species' status overall in the action area.

Coggins and Walters (2009) assessed the status and trend of the humpback chub in the LCR (the LCR Inflow aggregation) utilizing the ASMR model. As of 2008, the adult (age 4+) population of humpback chub was estimated to be about 7,650 fish, with a range between 6,000 and 10,000 fish. The ASMR indicates that a decline in the abundance of adult humpback chub occurred throughout the late 1980s and early 1990s, reached a low in the early 2000s, and has since trended upwards. This recent upward trend represents about a 50 percent increase in adult abundance since 2001 (Coggins 2008a, Coggins and Walters 2009) with the population size continuing to increase. The 2006 estimate was 5,300-6,700, an increase of about 50 percent since 2001 (Coggins 2008a, Coggins and Walters 2009). The change in status was due to an increase in recruitment that began before many actions predicted to improve the humpback chub status (such as mechanical removal of non-native fishes or warming of mainstem water temperatures in the Colorado River). Mainstem warming and mechanical removal effects both started in 2003 and could have begun affecting the abundance of age-2 recruits in 2004 and later, (brood-years 2002 and later).

Other monitoring information developed through the GCDAMP also indicates humpback chub status has been improving over the past decade. USFWS monitoring efforts in the LCR indicate that beginning in 2007 the abundance of adult humpback chub ≥ 200 mm (7.9 inches) in the LCR during the spring spawning season significantly increased compared to estimates obtained between 2001 and 2006 (Van Haverbeke et al. 2011), and have continued to trend upwards. Furthermore, all post-2006 spring abundance estimates of humpback chub ≥150 mm (5.0 inches) in the LCR do not differ statistically from the spring 1992 estimates obtained by Douglas and Marsh (1996). Finally, all post-2006 spring abundance estimates of humpback chub between 150 and 199 mm (5.0 and 7.8 inches) in the LCR (Van Haverbeke et al. 2011) appear to have equaled or exceeded the estimate of mean annual adult mortality provided in Coggins and Walters (2009). These findings are significant because the objective and measurable recovery criteria in the recovery goals (USFWS 2002a) require that the trend in adult abundance does not decline significantly, and that the mean estimated recruitment of age-3 (150-199 mm [5.0 and 7.8 inches]) naturally produced fish equals or exceeds mean annual adult mortality. It would appear that at least the portion of the LCR aggregation that enters the LCR to spawn each spring have returned to levels of abundance documented in the early 1990s.

Most of Reclamation's conservation measures for humpback chub from the 2008 Opinion have either been implemented or are in the process of being implemented. The AMWG accepted the completed Humpback Chub Comprehensive Plan in August 2009, and Reclamation is currently implementing many aspects of the plan (Glen Canyon Dam Adaptive Management Program 2009). For example, translocations above Chute Falls were conducted every year between 2008 and 2011. Working with NPS, translocations have also occurred into Havasu and Shinumo Creeks. A genetics management plan for humpback chub was also completed in 2010. The annual work plan for GCMRC describes the survey, monitoring, and research work related to the conservation measures for humpback chub (USBR and GCMRC 2012).

The Near Shore Ecology study began in 2008 and field work concluded in 2011. The NSE project was designed to estimate monthly survival estimates of juvenile humpback chub between 40-80 mm (1.57 and 3.15 inches) to assess population responses to experimental steady flows. Three master's theses were completed from the work done on the NSE (Dodrill 2012, Finch 2012, and Gerig 2012). New studies on humpback chub at the LCR inflow are continuing with portions of this work being lead by Dr. Josh Korman and GCMRC.

Shinumo Creek Translocation

In June 2009, GRCA and Grand Canyon Wildlands Council translocated 300 age-1 humpback chub into Shinumo Creek. Following the 2009 humpback chub release, two monitoring trips, pre- and post-monsoon, were scheduled. The pre-monsoon monitoring trip was completed in July 2009. To help monitor potential downstream movement of translocated fish, two remote PIT tag antennas were installed in the lower end of the system above a waterfall near the mouth of Shinumo Creek. Monitoring indicated high retention of fish in the creek; 108 were captured in July, only six of which were below the falls, the rest in the two mile reach above the falls; the majority of these fish were in the same general location where they were released. Of the six humpback chub captured in the short reach below the falls, three (two young of year, and one 1-year old) were unmarked (Grand Canyon Wildlands Council 2009).

Additional stocking occurred in 2010; and the third translocation of humpback chub into Shinumo Creek occurred on June 21, 2011, when three hundred young humpback chub averaging 89 mm (3.5 inches) were stocked (Healy et al. 2011). Supplemental translocations were also conducted in 2010 and 2011 (Healy et al. 2011). The 2011 field season documented 54 of the translocated humpback chub including 5 from the 2009 stocking season and 36 from the 2010 season (Healy et al. 2011).

Translocated humpback chub in Shinumo Creek were monitored in June, 2012 (Nelson et al. 2012a). A total of 116 unique humpback chub were captured; two from the 2009 cohort, 24 from the 2010, and 90 from the 2011. Monitoring in September, 2012 (Nelson et al. 2012b) captured 89 unique humpback chub, two from 2009, 18 from 2010, and 69 from 2011. An additional 200 humpback chub were stocked into Shinumo Creek in June, 2013 (NPS data).

As part of the 2012 mainstem aggregations survey in September (USFWS 2013), hoopnets were set in the river near the Shinumo Creek confluence. Of the 52 humpback chub captured in the river, 42 were fish originally translocated to Shinumo Creek. Ten were from 2009, 14 from 2010, and 18 from 2011. Sub-adult humpback chub (approximately 150mm [six inches]) were also captured. Previously, captures of young fish indicates that successful spawning has occurred as this aggregation (Ackerman 2008, Grand Canyon Wildlands Council 2009). This indicates that while translocated humpback chubs may not always remain in the creek, they do form part of the wild adult population at the aggregation and may be important for the expansion of that population in the future.

As part of the Shinumo Creek translocation, over 900 rainbow trout were removed from the stream in May and June 2009, in preparation for the first humpback chub release. Fisheries biologists also removed 394 rainbow trout from Shinumo Creek during the 2011 field season (Healy et al. 2011). During 2012, three rainbow trout removals occurred; February with 336 trout removed (Omana Smith and Healy 2012), June with 571 trout removed (Nelson et al. 2012a) and September with 195 trout removed (Nelson et al. 2012b). The 2012 data indicates that there are fewer rainbow trout in the creek, and the length frequencies have declined as the population becomes dominated with small, young, trout due to competitive release on young fish from the removal of the larger, predatory, adult fish (Nelson et al. 2012a). Humpback chub, bluehead sucker and speckled dace are also documented, measured, and returned to the creek during these targeted trout removals.

Havasu Creek Translocation

In June 2011, 243 humpback chub approximately 95 mm TL (3.7 inches) were translocated to Havasu Creek in fulfillment of the translocation Conservation Measure of the 2008 Opinion. Native bluehead sucker (n=50), speckled dace (n=517), flannelmouth sucker (n=18), and unmarked humpback chub (7) were also documented in the creek, along with 22 rainbow trout (Omana Smith et. al 2011, Sponholtz et al. 2011).

The second translocation stocking occurred in May, 2012 (Nelson et al. 2012c). Three hundred humpback chub with a mean length of 125 mm (4.9 inches) were stocked into the creek. During pre-stocking monitoring, 106 of the 243 humpback chub stocked in 2011 were captured; three of these were ripe males, which documented very good growth rates over one year. October, 2012 monitoring (Nelson *et al*. 2012d) captured 151 humpback chubs from the 2011 (62) and 2012 (89) stocking events. Additionally, wild humpback chub were documented in the creek during both 2012 surveys. These are all adult fish over 200 mm (eight inches) and none were tagged at time of capture.

The spring 2013 survey in Havasu Creek documented two juvenile humpback chub that were likely spawned in the creek in 2012 and ripe males and females that were ready to spawn (Healy and Nelson 2013). This is the first known spawning of humpback chub in Havasu Creek. An additional 300 humpback chub were stocked on May 14, 2013 completing the third translocation included in the initial three-year project.

Bright Angel Creek Trout Removal

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. The mainstem in the vicinity of the creek currently supports the highest density of non-native brown trout in GRCA, and Bright Angel Creek is likely the most important spawning area for brown trout in the project area. Adult brown and rainbow trout in spawning condition have been captured entering Bright Angel Creek from the mainstem during the fall (Leibfried et al. 2005, Sponholtz et al. 2010, Omana Smith et.al. 2012). Bluehead and flannelmouth sucker also use the creek for spawning and trout removal projects are designed to avoid significant effects to these species.

Efforts targeting trout for removal from Bright Angel Creek began with a feasibility study in 2002. The feasibility study lasted 64 days from November 18, 2002- January 21, 2003, yielding 423 brown trout and 188 rainbow trout (Leibfried et al. 2005). Following the completion of the Bright Angel Creek Trout Reduction Environmental Assessment and Finding of No Significant Impact (NPS 2006b), the fish weir was re-installed and operated by USFWS on two occasions in 2006 and 2007. 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, GRCA reinitiated the weir and electro-fishing project in Bright Angel Creek (see 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 (1,800 feet) of Bright Angel Creek above the weir beginning in October 2010, then for approximately 1500 meters (4,500 feet) at the end of January 2011, followed by approximately 2700 to 2800 meters (8,100-8,400 feet) 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, but a large flood also occurred during September 2011 that may have impacted trout abundance as well. Among all trips, an average of between 66% and 93% of non-native trout were removed using three-pass depletion electro-fishing (NPS unpublished data). 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 sucker are being PIT-tagged during sampling events to facilitate survival analysis in the future.

During the winters of 2010-11 and 2011-12, 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 2012-13, 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. Electrofishing in the winter of 2012-2013 removed 14,000 trout, 88% brown trout and 12% rainbow trout from more than 10 miles of creek over several weeks of continuous effort (Healy et al. 2013). Previous years had documented that trout in the upper reaches of the creek were moving down to repopulate the treatment reach. In 2012-2013, electrofishing went further upstream to reduce those populations. As discussed above, this project will terminate without the implementation of the proposed action.

Mainstem Aggregation Monitoring

The nine mainstem aggregations were first monitored in the early 1990s (Valdez and Ryel 1995), again in 2002-2005 (Ackerman 2008), and in 2010 and 2012 (VanHaverbeke and Persons 2011) The 2012 monitoring was done in September (USFWS 2013) and the report summarized the capture data for 2002-2012. The LCR inflow aggregation is the largest and captures from 2010-2012 support this determination. Havasu Creek, Shinumo Creek and Middle Granite Gorge have the next most robust populations, with Lava to Hance and Bright Angel Creek having the smallest number of captures over the three year period. As noted under the Shinumo Creek translocation section, humpback chub from the translocation that move to the river are an important component of this aggregation (Nelson et al. 2012b). Once Shinumo Creek translocated fish leave the creek for the mainstem, they are unable to return due to a waterfall barrier. The wild humpback chub that are found in Havasu Creek are likely also associated with the mainstem aggregation. It is unclear if there is free movement between that creek and the river at all flow levels, or if there are periodic connections.

<u>Predation and Competition from Non-native Fish</u>

Predation and competition from non-native fish species constitute a serious threat to humpback chub and razorback sucker (Minckley 1991, Mueller 1995). Populations of warmwater fish predators are only locally found in most of the canyon with the most robust populations in the lower portion near Lake Mead (Valdez 1994, Leibfried 2005, Gloss and Coggins 2005, Valdez and Speas 2007). Populations of brown and rainbow trout are present in the upper and middle reaches of the river where most humpback chub are found. The warmwater predators, particularly bullheads and channel catfish overlap more with the razorback sucker near Lake Mead. During the warm-water period of the mid 2000s, warmwater fish were found in greater numbers and further upstream in Grand Canyon than in previous years (Johnstone and Lauretta 2004, Ackerman et al. 2006, Ackerman 2008). A risk assessment focused on increases in water temperature was completed and showed that some non-native predators could benefit from having warmer water in the canyon (Valdez and Speas 2007). Concerns about more continuous warm water periods leading to the expansion or establishment of warmwater nonnative fish predators in the canyon were more strongly voiced in this period along with concerns that existing monitoring techniques are not able to effectively document increases in populations or distribution (Johnstone and Lauretta 2007, Hilwig et al. 2009).

Brown trout and rainbow trout are both predators on fish, with brown trout being the more piscivorous (Yard et al. 2011). As described in USFWS (2011a), trout removal actions were in place there after 2003. Because populations of rainbow trout from Lees Ferry down past the LCR confluence were considered a concern to the local humpback chub population. As estimated by

Yard et al. (2011), during the removal years of 2003-2004, over 30,000 fish (native and non-native species combined) were consumed by rainbow trout (21,641 fish) and brown trout (11,797 fish) (Yard et al. 2011). On average, 85% of the fish ingested were native fish species, in spite of the fact that native fish constituted less than 30% of the small fish available in the study area (Yard et al. 2011). According to Yard et al. (2011), even though rainbow trout had a large cumulative piscivory effect, the annual per capita consumption rate was low overall. On average, each rainbow trout consumed four fish/year (both native and non-native) in the upstream reach and 10 fish/year in the downstream reach. In contrast, per capita rates of fish consumption by brown trout were much higher: 90 fish/year in the upstream reach and 112 fish/year in the downstream reach, meaning that 200 brown trout could consume as much fish as 4,000 rainbow trout (Yard et al. 2011). The majority of the humpback chub consumed by trout were young of the year and subadults (age < three), and it is likely that the loss of so many young fish affects recruitment to the humpback chub population (Coggins and Walters 2009).

The abundance of non-native rainbow trout in the important LCR inflow reach has increased since the 2008 High Flow experiment (Makinster et al. 2009a, 2009b) and brown trout numbers in Reach 3 (RM 69.1-109) have increased every year beginning in 2006 (Makinster et al. 2010). Mainstem fish monitoring detected increases in rainbow trout in the LCR inflow reach of the Colorado River in 2008, prompting a removal trip in May of 2009. During the 2009 removal trip, AZGFD removed 1,873 rainbow trout. The 2010 catch per unit effort (CPUE) in reach 2 (RM 56-69) was similar to 2009, but CPUE in 2011 was nearly twice that of 2009. The 2012 survey documented a significant decline in the CPUE at the inflow area (Bunch et al. 2012) and the reason for this sharp decline is unknown. These estimates may indicate that rainbow trout are likely increasing throughout Marble Canyon. Unlike the situation in 2003, however, the four native fish species occurring in Grand and Marble Canyons, flannelmouth sucker, bluehead sucker, speckled dace, and humpback chub, are still very abundant in the LCR inflow reach (Makinster et al. 2009b, Van Haverbeke et al. 2011).

<u>Humpback Chub Critical Habitat</u>

Critical habitat for humpback chub in the action area consists of Reach 7, a 173-mile (278-km) reach of the Colorado River in Marble and Grand Canyons from Nautiloid Canyon (RM 34) to Granite Park (RM 208). The relevant PCEs for this consultation are in the Biological Environment; food supply (B1), predation (B2), and competition (B3) (Maddux et al. 1993a, 1993b, USFWS 1994). The physical environment PCE is not directly affected; however, removal of nonnative fish species may reduce competition for such sites and allow greater use by humpback chub and other native species.

Critical Habitat Reach 7 – Colorado River in Marble and Grand Canyons

Effects of the proposed action to critical habitat in Reach 7 are anticipated to occur primarily to the biological environment PCE as relates to nonnative fish populations. Food supply, predation, and competition elements are affected by the presence of nonnative fish in humpback chub critical habitat. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation, although considered a normal component of this environment, is out of balance due to brown and rainbow trouts (although other nonnatives may also be predators on humpback chub). This is also true of competition from nonnative fish species over food resources and habitat availability.

Although not related to the proposed action, we do consider the current state of the biological environment PCEs in Reach 7 of humpback chub critical habitat may be supporting the current population humpback chub. The proposed action will not affect the physical conditions that contributed to these changes; however, the proposed action may allow for better utilization of the improved conditions. These PCEs have responded to the post-dam changes to the ecosystem, particularly since river management changes beginning in the 1990s. Productivity is much higher in terms of algal and invertebrate biomass, thus food availability for fishes (PCE B1), especially adult fishes, is likely greater than pre-dam (Blinn and Cole 1991), although the previously discussed effects of cold water temperatures and fluctuations on the nearshore environment may inhibit the optimal suitability of nursery habitats (P2) and feeding areas (P3) for juvenile warm water fishes like humpback chub in most years. Grand et al. (2006) found that the most important biological effect of fluctuating flows on backwaters is reduced availability of invertebrate prey caused by dewatered substrates (see also Blinn et al. 1995), exchange of water (and invertebrates) between the main channel and backwaters, and (to a lesser extent) reduced temperature. As the magnitude of within-day fluctuations increases, so does the proportion of backwater water volume influx, which results in a net reduction in as much as 30 percent of daily invertebrate production (Blinn et al. 1995, Grand et al. 2006). However, recent investigations into the use of nearshore habitats in the mainstem just downstream of the LCR by 0-3 year old humpback chub (40-199 mm [1.6-7.8 inches] TL) indicate that the PCEs of critical habitat in the area immediately downstream of the LCR confluence appears to be functioning properly and may support recovery. Juvenile humpback chub used a variety of mainstem nearshore habitats, and survivorship and growth of fish in these habitats was documented (Dodrill 2012, Finch 2012, Gerig 2012). Humpback chub in other aggregations in Marble and Grand canyons also appear to have persisted and possibly increased in size in recent years (Van Haverbeke and Persons 2011); other native fish including flannelmouth sucker that have similar habitat needs have also increased in abundance in western Grand Canyon (Makinster et al. 2010). Thus, there are several lines of evidence indicating that the biological environment PCEs of critical habitat in Reach 7, although limited, may have improved in recent years which is important for recovery.

Non-native fish species that prey on and compete with humpback chub affect the PCEs (B2 and B3) of the biological environment aspect of critical habitat. Catfishes (channel catfish and black bullhead), trouts (rainbow and brown trout), and common carp are well established in the action area and will continue to function as predators or competitors of humpback chub. Minckley (1991) hypothesized that non-native fish predation and competition may be the single most important threat to native fishes in Grand Canyon (Valdez and Ryel 1995, Marsh and Douglas 1996, Coggins 2008b, Yard et al. 2008). Valdez and Ryel (1995) estimated that 250,000 humpback chub are consumed by channel catfish and, rainbow and brown trout annually. Small-bodied species such as fathead minnow, red shiner, plains killifish, and mosquitofish are also found in nearshore areas of Marble and Grand canyons and may be important predators and/or competitors of juvenile humpback chub in nearshore habitats. Marsh and Douglas (1997) suggested that entire year classes of humpback chub may be lost to predation by non-native fish species, and Yard et al. (2008) estimated that, although predation rate of rainbow trout on humpback chub is likely low, at high densities, trout predation can result in significant losses of juvenile humpback chub. Yard et al. (2011) also concluded that even though predation levels were high (humpback chub comprised approximately 30% of the identifiable fish in trout stomachs), it is not evidence that there was a population-level effect on humpback chub.

Efforts by the GCDAMP to mechanically remove non-native fishes in the LCR inflow reach were successful in removing trout (Coggins 2008b). In total, between January 2003 and August 2006, it is estimated that approximately 36,500 fish from 15 species were removed from this stretch of river. However, due to a system-wide decrease in trout populations independent of the removal effort and warmer river temperatures, it is unclear whether removal of trout contributed to the increases seen in native fish populations. Yet stomach sample analyses, show that rainbow and brown trout predation on native fishes clearly occurs.

The level of non-native fish decreased over the next three years resulting in non-native fish comprising only 10% of the species composition in August 2006 (Coggins et al. 2011). Species composition and abundance of non-native fishes is dynamic and affected by natural conditions and other factors throughout the canyon, with colder water species dominating closer to the dam, and warm water species downstream. Common non-native fish species in Grand Canyon, such as channel catfish, black bullhead, common carp, rainbow trout, brown trout, and fathead minnow likely spawn in the mainstem river and in nearby tributaries or tributary mouths, although more information is needed on spawning locations to better target control efforts (Hilwig et al. 2009). Immigration of non-native fishes from basins that feed into Grand and Marble canyons is also a source of non-native fish (Stone et al. 2007), and stocking of sport fish in these basins is an action that may contribute to source populations of non-native fish that invade the mainstem river, although the 2011 Sport Fish Opinion (USFWS 2011c) has concluded that this is not a significant factor. Lake Powell and Lake Mead are also sources of non-native species as evidenced by the presence of walleye (*Sander vitreus*) and green sunfish in Glen Canyon (AZGFD 2008) that either were illegally stocked or came through Glen Canyon Dam, and striped bass, which likely move up from Lake Mead and are common in lower Grand Canyon.

However other mortality factors, such as disease, are not known. Just as the ultimate causes of the improved status of humpback chub is not known, a causal link between removal of non-native fish and humpback chub population parameters has not been established (Coggins 2008b). However, removal efforts are one suspected cause or contributor to recent increases in humpback chub recruitment (Andersen 2009).

In the 2008 and 2009 Supplemental Opinions (USFWS 2008, 2009), we stated that the biological environment PCE for food base (B1) appears met for adult humpback chub, but may be limiting for juveniles. This was because available information indicated that adult humpback chub in the mainstem portion of the LCR reach had a higher condition factor compared to those in the LCR (Hoffnagle et al. 2006). We now question whether B1 is being met for adult humpback chub in all parts of Reach 7, given the small size of other mainstem aggregations. Based on some preliminary research on food base, it appears that in years when discharge is high over the winter, and light levels are low, primary production is very low (Yard 2003). Algae is readily consumed by aquatic invertebrates (i.e., midges and black flies; Stevens et al. 1997, Wellard Kelly 2010, T. Kennedy, USGS, written communication, 2011) that are important food items eaten by native and non-native fish in the system (Valdez and Ryel 1995, Donner 2011, Zahn-Seegert 2011), and native fish including humpback chub also directly consume algae (Valdez and Ryel 1995, Zahn-Seegert 2011, Donner 2011). As fish need to have sufficient food resource reserves (lipids) in order to produce eggs, humpback chub could get the lipids they need from direct consumption of algae or from consumption of invertebrates on the algae that are themselves rich in lipids. One possible reason for the near absence of documented spawning in the downstream reaches and small aggregation size may be the lack of food resources (lipids) over the winter months to prepare adult humpback chub to be able to mature eggs in spring. Some of the tributaries such as Havasu and Kanab creeks are warm enough to allow for spawning, and the discovery of untagged humpback chub in Havasu Creek in June 2011 (Smith et al. 2011, Sponholtz et al. 2011) and May and October 2012 (Nelson et al. 2012c,d) suggests that the habitat and food resources are supportive of humpback chub using Havasu Creek for at least part of the year, where spawning occurred in 2012 (Healy and Nelson 2013). We believe that additional information is needed to evaluate overwintering conditions, and specifically whether the rates of primary production and food resources over the winter months are sufficient to prepare humpback chub to spawn/reproduce the following spring, especially in the western portion of Reach 7.

PCEs B2 (competition) and B3 (predation) continue to threaten the conservation of humpback chub in Reach 7.

The proposed action relates to the portion of the Recovery Goals that address the proliferation and spread of non-native fish species that prey on and compete with humpback chub. The Recovery Goals identify the need to develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking sport fish to minimize escapement of non-native fish species into the Colorado River and its tributaries through Grand Canyon. Stocking, both legal and illegal, throughout the LCR basin, has been suspected of resulting in non-native fish moving into the lower LCR (Stone et al. 2007), and likely into the mainstem Colorado River as well. Measures for monitoring nonnative fish communities and responding to new introductions assist in controlling this threat.

The Recovery Goals also identify the need to develop and implement levels of control for rainbow trout, brown trout, and warm water non-native fish species (USFWS 2002a). Non-native fish control has been a focus of the GCDAMP for some time. The degree to which these removal efforts have improved the PCEs B2 and B3 is still a research question, although Yard et al. (2008) estimated that the 2003-2006 removal of rainbow and brown trout contributed significantly to reduce predation losses of juvenile humpback chub. Andersen (2009) and Coggins and Walters (2009) noted the potential role these removal efforts may have had in improving the status of the humpback chub in Marble and Grand Canyons, but the available information is insufficient to evaluate the effects of removal alone. The GCDAMP and GCMRC have been testing various methods to monitor and remove warm water non-native fish species, so far with little success. Information on which non-native species should be removed during which times of the year continues to be a research question.

Razorback sucker

At full-pool elevation (1229 ft [375 m] NGVD), Lake Mead impounds water up to Separation Canyon (RM 239.5); however, the effects of “ponding” of water (reduced velocity and increased sediment deposition) can extend upstream for several miles to Bridge Canyon (RM 235) as noted by Valdez (1994). Lake levels have declined since the late 1990s, reaching a low of 1081 feet (329 m) in November, 2010. This decrease in lake elevations increases the length of "riverine" habitat from Separation Canyon downstream and alters the structure of the habitat as the river downcuts through accumulated sediment and forms a channel with limited backwaters or shallow margins (Van Haverbeke et al. 2007). By 2011, the lake/river interface was in the upper portion of Gregg Basin (Kegerries and Albrecht 2011). How razorback sucker use the riverine portion versus the lentic portion of the Colorado River inflow area and how use may change with lake elevation is yet unclear.

In 2012, three sonic-tagged razorback sucker from Lake Mead were detected by sonic sensors placed near Quartermaster Canyon (RM 260) (Kegerries and Albrecht 2012). Further, an adult male razorback sucker was captured during fish community surveys by AZGFD in October, 2012 at RM 246 (Bunch et al. 2012). These new data indicate that razorback sucker are using the Colorado River inflow area for spawning and recruitment and are moving up into the Grand Canyon at least temporarily

Razorback Sucker Critical Habitat

Critical habitat for the razorback sucker extends from the mouth of the Paria River downstream to Hoover Dam, including Lake Mead to its full-pool elevation. Maddux et al. (1993b) discussed how the PCEs for razorback sucker function in this reach; we summarize that discussion below.

In the riverine portion of the reach (Paria River to Separation Canyon), the PCEs for water, physical habitat, and biological environment have been altered by creation of Glen Canyon Dam as described earlier for the humpback chub. The suitability of the physical habitat conditions for razorback sucker in this reach were likely significantly less even before closure of the dam as razorback sucker are generally not found in whitewater habitats that are home to humpback chub (Bestgen 1990).

There is information that indicates that at least some portions of the Colorado River through the canyon can provide the physical PCEs needed by razorback sucker. The most recent report is from a raft survey in 2009 (Speas and Trammel 2009) where the reach from Lava Falls to South Cove of Lake Mead (in Gregg Basin) was visually evaluated for habitat features that could support razorback sucker populations. Features evaluated included backwaters, islands/side channels, habitat types (runs, riffles, eddies, spawning cobble, shallow waters), cover (turbidity or vegetation), and water temperatures. Using these features, reaches of the river were determined have complex, less complex, or poor habitat quality for razorback sucker. Complex habitat extended from Lava Falls to Granite Park (RM 179-208), and Granite Spring to near 224 mile (RM 220-223). Less complex habitat was found from Granite Park to Trail Canyon (RM 209-219) and 224 mile to Last Chance Rapid (RM 224-253). Poor habitat extended from Last Chance Rapid to Pearce Ferry (RM 253-279). The poor habitat began 14 miles (22.5 km) below the full pool elevation of Lake Mead and was characterized as a straight, incised channel with little backwater areas and predominately swift run habitat. This condition extended further to the upper end of Gregg Basin where the river-lake interface was located in 2011 (Kegerries and Albrecht 2011).

The lower Grand Canyon native fish fauna is affected by the nonnative fish community moving upriver from Lake Mead (Valdez 1994, Ackerman et al. 2006, Van Haverbeke et al. 2007, Ackerman 2008, Makinster et al. 2010) and large populations of non-native predators and competitors are present that affect all three biological elements. Flannelmouth sucker, bluehead sucker, and speckled dace are the native species found. Razorback sucker, flannelmouth sucker and hybrids of the two species were found in Gregg Basin in 2011 and 2012 (Kegerries and Albrecht 2011, 2012). Like other areas in Lake Mead with successful razorback sucker spawning and recruitment, the inflow area is highly turbid, and that may provide cover for young razorbacks.

Existing Native and Nonnative Fish Survey, Monitoring, and Research Program in the Action Area

As part of the compliance for the operation of Glen Canyon Dam, the GCDAMP was developed in part to organize and implement conservation actions included in biological opinions and environmental impact documents. This program is led by the GCMRC with funded projects going to USGS, AZGFD, USFWS and consultants/universities that involve many disciplines. NPS personnel are cooperators with the GCDAMP and may be participate in these research and monitoring efforts. Of importance here is the native and nonnative fish component of this program and how it affects the humpback chub and razorback sucker.

The most recent description of the program is in the 2013-2014 Budget (USBR and GCMRC 2012). Five Project areas are identified:

- Project D: Mainstem humpback chub aggregation studies and metapopulation dynamics
- Project E: Humpback chub early life history in and around the Little Colorado River
- Project F: Monitoring of native and nonnative fishes in the mainstem Colorado River and lower Little Colorado River
- Project G: Interactions between native fish and nonnative trout
- Project H: Understanding the factors limiting the growth of large rainbow trout in Glen and Marble canyons.

Within each Project, there are several project elements that address specific issues and require certain types of actions to be taken to obtain the necessary data. Most, but not all, of the project elements involve the deliberate capture and handling of humpback chub as part of the actions. Other project elements may incidentally encounter humpback chub or razorback sucker while the focus is on other species or resources. The effects to humpback chub and razorback sucker from the implementation of these project elements are directly related to the techniques used. In some cases, the techniques are described in the project description. Where they are not, GCMRC was queried to obtain this information. Table 2 lists the project elements that have the potential for effects to humpback chub and razorback sucker.

While none of the ongoing NPS activities that are part of the proposed action are included in Table 2, NPS personnel may participate on the trips associated with one or more project elements to assist in data collection activities.

Potential effects from project elements on humpback chub and razorback sucker fall into several categories:

- Effects related to capture devices (electrofishing, nets, and traps).
- Effects related to handling of captured fish (removal from capture devices, temporary holding for processing, weighing, measuring, scanning for internal tags, insertion of internal tags, gastric lavage, and fin clipping or other tissue removal are examples of handling actions) including experience of the handler.
- Number of times an individual is exposed to capture or handling over time (recaptures in same or subsequent years).
- Physical conditions at the time of capture, particularly water temperature
- Inadvertent injury or mortality from survey, monitoring, or research activities not related to project elements targeted to these species.

The result to an individual fish of exposure to the actions involved in the project elements will vary from minor (no physical injury and low stress response) to significant (physical injury or high stress levels that may result in immediate or delayed mortality) depending on the species and how the actions are implemented. As described in the proposed action, biological survey, monitoring, and research work in the Colorado River and tributaries in the action area is subject to tagging and handling protocols that are designed to reduce the risks of high stress or physical injury to individual fish captured and handled (Persons et al. 2013). These apply to all project elements, and some may have additional restrictions not included in those protocols that are part of conditions in their section 10(a)(1)(A) permits.

Most project elements that involve humpback chub or razorback sucker require multi-day boat trips on the Colorado River to collect data. The majority of these trips launch at Lees Ferry with take out near Diamond Creek (RM 225) or Pierce Ferry where there is road access to retrieve boats and personnel. The number of boat trips per year varies with the needs of the project elements and other purposes such as cultural resources trips for the Tribes to conduct their monitoring. As shown in Table 3, the majority of the GCMRC trips in 2012 and 2013 that involve biological work are in the Lees Ferry area and are unlikely to encounter humpback chub or razorback sucker.

Some project elements do not require river trips as their sampling/monitoring locations are accessible from existing roads or other means. Work on the river done in the Lees Ferry Reach (Glen Canyon Dam to Lees Ferry) is accessed from the boat launch at Lees Ferry (this is also were most river trips to downriver sites are launched). Activities on the LCR itself are accessed via helicopter, as is delivery of humpback chub for translocation in Shinumo and Havasu creeks. There is also road access to Diamond Creek, and projects at that site and downstream to Lake Mead are launched there. The GCMRC program also focuses on reducing the number of times an individual fish is exposed to project elements by attempting to combine river trips where data is gathered to as few as practical and that captured fish are handled to produce information usable for more than one project element whenever possible. This also promotes efficiency in river trip management, which is a cost savings and allows more funding to be used for the actual field work.

NPS plans its own trips to Bright Angel, Havasu, and Shinumo creeks using boats launched at Lees Ferry. Some personnel access to Bright Angel, Shinumo, and Havasu creeks is hike in with equipment helicoptered in initially and stored or augmented for each trip combined with delivery of other equipment or personnel via boats in use for other purposes Yearly, one trip is made to Bright Angel Creek, two to Havasu Creek, and three trips to Shinumo Creek by NPS (Table 4). The Bright Angel Creek "trip" actually lasts from October to early March with crews rotated out weekly. Trips to Havasu and Shinumo creeks last less than two weeks each with the same crew working the area.

Trout Management Flows/Mechanical Removal

Under the 2011 BO (USFWS 2011a), Reclamation is required to address rainbow trout at Lees Ferry and the LCR confluence in three ways. The most developed of these is the plan for mechanical removal at the LCR that is triggered by a combination of humpback chub population metrics and the number of rainbow trout found during surveys in January of each year. Unless the triggers are met, no mechanical removal is required.

The other two facets of this program are more experimental in nature. The efficacy of removing rainbow trout from the Paria River-Badger Rapids reach by concentrated electrofishing was to have been tested in 2012. The documentation of whirling disease in the Lees Ferry rainbow trout population precluded these tests since live removal was not possible to avoid spreading the disease. This program is considered to be under temporary suspension pending development of options for live removal.

The last component is the development of suppression activities using both flow and non-flow actions in the Lees Ferry reach to reduce recruitment of rainbow trout and subsequent emigration of those trout to Marble Canyon and the LCR. Reclamation has two years from the signing of the FONSI in 2012(USBR 2012b) to implement this project. Additional environmental compliance may be needed for some aspects of this project.

While mechanical removal at either the Paria River-Badger Rapids or the LCR is not ongoing, Reclamation reserved the right to consider implementing some sort of trout control in the event of new information about location or numbers of rainbow trout in the river.

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The effects of the action fall into two categories; (1) effects from capture and handling of humpback chub and razorback sucker during targeted survey and monitoring actions and translocations as well as incidental contact with these two species during projects focused on the wider fish community in the project area and (2) management actions to restore the Lees Ferry rainbow trout fishery to its former high quality status and in doing so address recruitment and emigration issues that affect native fishes downstream.

CAPTURE AND HANDLING

Humpback chub and razorback sucker are subject to capture by nets or electrofishing actions targeted at them or that are part of other species monitoring and nonnative removal efforts where individuals may be incidentally encountered.

The effects of capturing fish species is related to the type of sampling gear, size and age class of the fish, and the conditions under which the fish are captured. All methods result in some level of stress to the captured animal, and the results of that stress can vary from species to species and within different lineages of the same species (Cone and Krueger 1988, Hunt 2008). The peer-reviewed literature on capture and handling stress on fish provides extensive documentation of this effect. The standard guidelines in books on fisheries management (Nickum 1988, Schreck and Moyle 1990, Murphy and Willis 1996, and Bonar et al. 2009) were designed around this knowledge to incorporate guidelines that minimize the potential for injury and mortality during survey and monitoring activities. For this project, the protocols in Persons et al. (2013), included as conservation measures in the proposed action, and included in section 10(a)(1)(A) permits are designed to reduce the risk of injury or death to captured humpback chub and razorback sucker.

Electrofishing

Electrofishing is intended to stun fish so that they can be collected in dip nets. Both backpack and boat-mounted units are proposed for use under the proposed action. While this is effective method of sampling, it sometimes can result in injury or death of fish depending on their size, water chemistry, level of power/wattage used and the experience level of personnel operating the generator or electrofishing unit (Holliman et al. 2003). Snyder (2003) examined in depth the appropriate use of electrofishing in fisheries management and the effects to fish that encounter the electric field. The extent of injury or mortality is related to the type of current (AC is more harmful than DC), the strength of the electric field (lower is less harmful), and the time of exposure to the field (lower is less harmful). There are a number of contributing factors to the degree a fish is affected by the electric field that are fully discussed in Snyder (2003).

Injury to fish subjected to an electric field is largely the result of the response of the fish when the nerves are stimulated by the field. This response ranges from reactive detection (where the fish can begin to sense the field and it may stay or flee) to undirected/inhibited swimming or neurotaxis to narcosis and tetany. Effects can include cardiac or respiratory failure (asphyxiation), injury to the spinal column because of the seizures caused by tetany, bleeding from the gills, stress (increased plasma cortisol or plasma glucose), and fatigue. The removal of the affected fish from the electric field as quickly as possible reduces the potential for significant injury to occur (Snyder 2003). Fish subjected to multiple-pass electrofishing are more likely to have adverse reactions in blood chemistry (Densmore and Panek 2013) and trauma (Panek and Densmore 2013) than fish subjected to single pass electrofishing.

Conservation measures included in the proposed action and permits are designed to reduce the risk of injury to fish from electrofishing; however, mortalities may still occur (VanderKooi 2012).

NPS proposes to continue one multiple pass-electrofishing in Shinumo Creek during the winter to assess the rainbow trout population to minimize effects to humpback chub there from the potential effects of repeated passes. No injuries or mortalities to humpback chub have been documented from the ongoing project. Multiple pass electrofishing in Bright Angel Creek to remove nonnative trout has not yet had any effect to humpback chub since they are not in the creek. Should humpback chub be translocated to the creek in the future, any electrofishing would be done under a protocol similar to that for Shinumo Creek. No electrofishing is expected in Havasu Creek. In the mainstem, a new project to remove nonnative fish from near Bright Angel Creek is proposed and would have one, up to 20-day trip in the fall with multiple passes. Humpback chub may be incidentally captured during this event. There is a risk that individual humpback chub in this aggregation may be exposed more than once to the electric field. This aggregation is very small (USFWS 2013) and the number of fish potentially effected is limited.

Additional boat-mounted electrofishing below Lava Falls in conjunction with the razorback sucker project may also inadvertently capture humpback chub near the aggregation at Pumpkin Spring. Single pass electrofishing would be used for razorback sucker work since the emphasis is on capture of this species, not removal of nonnative fish. This is a small aggregation and the number of humpback chub potentially affected is limited (Ackerman 2008, USFWS 2013).

Additional electrofishing in the event of an emergency response could affect unknown numbers of either humpback chub or razorback sucker depending on the location of the response treatment. Use of electrofishing protocols during these actions should reduce the potential for adverse effects.

Netting (Passive and Active)

Passive nets are those that are set and then checked periodically to assess the capture of fish. Trammel nets, hoop-nets, and minnow traps are passive nets. Seines and dip nets are active nets as they are moved through the water by field crews to capture fish. There is not a companion protocol for use of nets and fish traps (minnow traps or hoop nets) by researchers in the Grand Canyon; however, most projects (including those undertaken by NPS under this project) do follow some basic guidelines:

- No use of trammel nets unless the water is less than 16˚C (60˚F). Trammel nets must be checked every two hours and will not be set in the same site two nights in a row.

- Baiting of hoop nets is not allowed in the LCR except in conjunction with capture of small humpback chub for translocations by USFWS. Baiting is allowed in the mainstem and other tributaries as needed.

Trammel nets can capture larger fish effectively when used properly; however, there is always a level of stress involved that can be fatal in some more sensitive species (Hunt 2008, Hunt et al. 2012, Paukert et al. 2005). Fish can end up injured or dead from the physical trauma or exhaustion while in these nets, especially when set in flowing water such as the Colorado River. Individuals can also be killed if left in these nets too long, and the combined stress of time in the net plus the handling can cause delayed mortality.

Use of trammel nets by NPS would be limited to razorback sucker monitoring and any future emergency response actions. Current limitations on use of trammel nets based on temperature and time between checking for captured fish are designed to reduce the potential impact on fish captured in the nets. The NPS proposed action would increase the use of trammel nets (annually) in the lower canyon; however, coordination with the GCMRC/USFWS aggregation monitoring project to schedule which aggregations would be monitored by which agency each year will reduce the number of trammel net sets at aggregations where they are used..

Traps such as hoopnets and minnow traps are less likely to result in physical trauma as the capture is passive and the fish either swim into these traps randomly or are baited into them. Some fish may be captured with a predatory fish or a larger fish that may begin eating smaller fish within the trap, resulting in mortality of the smaller fish or size classes. Captured fish may be damaged if the hoopnet is flattened and fish are trapped in the folds. Similarly, seines pulled up onto shore may have bunched material that can harm individuals. The act of seining can also injure fish if they are trampled by the field crew on the shoreline or in the seine. With small fish, the act of picking them up out of the seine can cause injury if not done with care. Damage to the mucus coating on a fish's skin can be avoided by having wet hands before handling fish.

Use of hoopnets and minnow traps under the proposed action is expected to increase if humpback chub are translocated to Bright Angel Creek, with the additional trip to monitor the Shinumo Creek aggregation, and with expanded monitoring at Kanab Creek and other tributaries. Hoopnets might be used in emergency response actions if the target species is susceptible to that type of net. NPS field crews are experienced in setting and retrieving these types of nets and significant injury or mortality issues have not arisen.

More active methods of capture include dip nets, hand captures, angling, and seines. These methods are less likely to result in injury or death from being left too long attached to the gear. The use of angling may result in hook-related injuries that may affect feeding, but all hooks to be used in angling are unbarbed to reduce this risk. In some cases, the use of hook and line to capture fish can result in the fish swallowing the hook or a hook snagging a fish. This can lead not only to injury, slowing the intake of food, but also to death as a result of stomach perforations associated with swallowing hooks. There is a delayed mortality factor with hook and line captures where the fish has not been quickly released (Bartholomew and Bohnsack 2005, DuBois et al. nd). Normally, following the protocol in Persons et al. (2013) not to use bait for nonnative species removal, NPS will not use bait while angling to remove rainbow trout or other nonnative fish species.

The targeted removal of YOY humpback chub from the LCR for off-site rearing is generally done with baited hoopnets with seines or other small handnets used if hoopnets are ineffective due to high sediment loads and the individuals are then placed in holding containers until transported out of the canyon. Targeted collection of razorback sucker larvae (larvae will be kept for analysis) will be done with seines and while areas of known humpback chub occupancy (Pumpkin Spring) will be avoided, there is a risk that some humpback chub larvae could be incidentally taken during these actions.

The act of field crews moving through the water with nets or other equipment also has a risk to eggs or larvae if activities are conducted during the spawning and nursery period for a species. Activities in the stream may also stir up sediments that temporarily increase turbidity and may result in re-deposition of these sediments on hard surfaces that support algae or other food resources. Accessing streams from the banks may also disturb rooted vegetation that may result in bank erosion. Minimization of these effects is difficult, particularly when multiple net sets or electrofishing actions occur over a longer period of time such as in Bright Angel Creek for the weir and electrofishing work in the winter. Work at Shinumo occurs three times a year for a few days at a time and the intensity is much less than at Bright Angel. Havasu Creek is visited two times a year, again for a limited period. The number of these visits does not increase over the baseline (see Table 4), and we expect limited impacts to fish or habitat from this work. If translocations of humpback chub do occur in Bright Angel Creek, the extensive nonnative removal would be re-fashioned to reflect the need to protect the translocated fish.

Handling Stress

Removing fish from various sampling gear, holding, handling, and release can also result in injury and mortality from physical trauma, secondary infections, and stress (Cho et al. 2011, Francis-Floyd 2009, Harper and Wolf 2009, Portz et al. 2006, Sharpe et al. 1998). Handling may include data collection on reproductive status (palping for egg masses), physical measurements, weighing, marking of individuals, and taking tissue or gastrointestinal content samples.

Marking individuals with fin clips, PIT tags, nares tags, coded wire tags, Floy tags, fluorescent dyes, and possibly branding or tattooing is common practice and carries some degree of risk due to injection or surgery (Ward 2003, Ward and David 2006, Montony 2008, Northwest Marine Technology 2008, Ward et al. 2008, Mulcahy 2013). Marking with any of these methods can result in entry sites for secondary bacterial or fungal infections that could permanently disable or kill individuals. Restraining fish while measurements, fin clipping, or tagging are completed can also cause damage if fish are held too tightly. Persons et al. (2013) describes the techniques for tagging that include the use of ethanol or isopropyl alcohol to disinfect PIT tags and the needles used to insert the tags. These protocols reduce the risk of infection in tagged fish.

Effects to the Population from Collection Actions

The CFMP will target humpback chub for capture as part of translocation, post-translocation monitoring, and species monitoring in the mainstem. With the exception of YOY or juvenile humpback chub removed for rearing and subsequent stocking for the translocation program, the majority of these individuals will be captured and examined then returned to the river or stream. The effect of these actions on the captured and handled individuals is assessed to determine if that effect has a significant effect on the population of humpback chub in the canyon and LCR as part of issuance of a section 10(a)(1)(A) permit. Generally, for continuing large-scale actions, a finite number of individuals that can be purposefully taken are not specified to allow for flexibility. The number of humpback chub to be handled by NPS field crews over the 20-year life of this project is likely to number in the thousands. The issuance of section 10(a)(1)(A) permits for actions by GCMRC, USFWS, and other researchers is coordinated such that the population is not over-handled.

Reports of incidental take for USFWS and GCMRC actions that involve capture and handling of humpback chub over the last five years indicates that immediate mortality of captured individuals is very low (Table 5) (Pillow 2013, VanderKooi 2012). Most mortality was not the result of handling but was from capture events (electrofishing and hoop nets) or loss of individuals in a laboratory setting (VanderKooi 2012). While not proof of limited post-capture mortality, multiple recaptures of all size classes of humpback chub over time suggest that capture and handling does not have a significant adverse effect on the population as a whole. Particularly in the LCR, where there is extensive survey and monitoring actions that capture many humpback chub each year (Pillow 2013), no adverse effects have been seen from capture or handling of individuals in that population. Due to other factors, the LCR population has increased in size since 2006 (Van Haverbeke et al. 2013).

Purposeful capture and handling of humpback chub by GRCA will increase under the proposed action due to continuation of the translocations to Havasu and Shinumo creeks and the potential addition of Bright Angel Creek to that program. Within the translocation streams, removal of nonnative fish may also incidentally contact humpback chub, with an increase in that contact over present levels if humpback chub are introduced into Bright Angel Creek. With the protective measures in place to reduce contact with humpback chub during nonnative removal trips, the amount of this capture is likely to be limited as indicated in the GRCA 2011 permit report information included in Table 5 (Rogers 2011). Non-target capture and handling will also increase from additional mainstem electrofishing in the Bright Angel Creek and Shinumo Creek aggregation areas and other mainstem fish community surveys (including that for razorback sucker downstream of Lava Falls). This increase is likely to be small due to the number of humpback chubs in these areas. Use of protective measures included in the proposed action should reduce the risk of injury or mortality to captured individuals.

The collection of YOY humpback chub to support translocations was examined to determine if this level of removal could damage annual recruitment to the LCR humpback chub population. Since 2008, 500 to 800 young humpback chub were removed annually from the LCR to provide individuals for translocations or other specific research. The individuals removed are small (most are 40-80 mm 1.5-3.1 in] and are subject to high natural rates of mortality. Pine et al. (2013) ran a series of simulation models to evaluate the effect of loss of YOY individuals from the population. The results of that simulation indicated that a level of annual removal of a few thousand larvae (2,000-3,000) would have little to no effect on the population size in future years. Further, based on the successful capture and rearing of humpback chub removed from the wild at <25-30 mm (~one inch) by GCMRC in 2012 (VanderKooi 2012), the USFWS is evaluating this size class for rearing at SNARRC in 2013 (K. Young, USFWS pers. comm. 2013). If this effort is successful, future captures for translocations will be of this smaller (and younger) size. Collecting these very young larvae in the spring instead of older larvae in late summer and fall will have even less effect since the younger larvae have a higher rate of natural mortality. While GRCA is including the purposeful collection of up to 500 juvenile humpback chub (one year old) for rearing, it is unlikely that this collection would be done unless larval collections failed. The effects of this removal on the adult humpback chub population would result in a < 1 percent change in abundance (Pine et al. 2013).

Humpback chub YOY may be incidentally collected during collection efforts for razorback sucker larvae below Lava Falls. Section 10(a)(1)(A) permits issued for purposeful take of razorback sucker for this project acknowledge the potential for this incidental take to occur. NPS personnel may be involved in these sampling efforts and incidentally take humpback chub in addition to those taken by the project contractors during those trips.

There is only one humpback chub spawning aggregation (Pumpkin Spring at ~ RM 212) in the razorback sucker study area and the number of adults present there is small (USFWS 2013); thus the number of larvae available over the April-October collection period is limited. For each year, 50 random collection locations (out of a possible 800 sites) will be visited to obtain the desired number of razorback sucker. Further, no collecting of razorback sucker larvae in the vicinity of known humpback chub aggregations at RM 194-196 and 212-216 further reduces the likely risk of encountering a humpback chub YOY during these collection efforts. Existing information on in-situ recruitment to this aggregation is lacking; however, that the population has not shown an increase in size over time indicates that recruitment is limited; implying that larval and YOY survival is also low. The limited incidental collection of larvae from this population over the three-year study is unlikely to have any effect on the local population of humpback chub.

The CFMP will target razorback sucker for capture in the lower canyon between Lava Falls and Lake Mead. Based on similar actions underway in Lake Mead since 1995, the number of wild razorback sucker injured or killed as a result of capture events is very low. The population size and distribution of razorback sucker in this area is unknown; there are wild-born and captive-reared and released individuals in the population. Captive-reared fish (originating as larvae collected from Lake Mead) are implanted with sonic tags before release to act as guides to locations frequented by wild razorback sucker. An unknown number of juvenile through adult razorback sucker will be captured and handled during the initial program. The effects to the population of razorback sucker in Lake Mead from use of these captive-reared individuals are not significant since the limited amount of larval removal that enables their development is minor compared to the number of larvae produced. Capture and handling of wild razorback sucker captured in the Grand Canyon is not significant to the overall Lake Mead population.

The collection of razorback sucker larvae to determine if razorback sucker are spawning in the Grand Canyon will remove a portion of the annual larval production. As with humpback chub, GRCA personnel may assist in this targeted collection effort. These YOY would be sacrificed for laboratory analysis. A female razorback sucker can produce 46,740-100,800 eggs a year (Bestgen 1990). Removal of up to 5,000 larvae per year for the three year larval sampling period is unlikely to have any significant adverse effect. Unlimited numbers of larvae could be handled and most of those would be returned to the river.

Based on the information presented above, the purposeful take of unlimited adult, sub-adult, and juvenile humpback chub by NPS and up to 2,000 YOY humpback chub by USFWS for NPS projects is unlikely to have any significant effect on the overall population of this species in the mainstem and LCR over the 20-year implementation of the CFMP. For razorback sucker, the purposeful take of unlimited adult, sub-adult, and juveniles for five years and up to 5,000 larval razorback sucker for three years is unlikely to have any significant effect on the overall population in Lake Mead and the lower Grand Canyon.

LEES FERRY RAINBOW TROUT MANAGEMENT

The proposed action includes the experimental stocking of sterile triploid rainbow trout (various age/size classes) in the event a decline in the rainbow trout fishery as measured by the three triggers included with the proposed action measuring low recruitment, low population size, and low catch rates. If these events do not occur, no stocking would occur. Triploid rainbow trout cannot reproduce, and they would only be stocked above the Paria River and only for the time needed to restore the fishery. If natural reproduction of wild trout stabilizes the populations, then additional stocking of triploids would not be needed.

Prior to stocking triploid rainbow trout, a monitoring program marking all stocked fish to track their movements would be implemented. If large numbers of triploids were to appear at the LCR, the stocking program would be re-evaluated in coordination with USFWS.

Triploid rainbow trout are created in the hatchery from normal trout eggs subjected to heat (Solar et al. 1984) or pressure (Lou and Purdom 1984). Techniques also exist to produce mixed sex (containing male and female fish) or female only (Lincoln and Scott 1983) cohorts. Many studies have looked at the growth of mixed and female only cohorts compared to normal diploid trout (Sheehan et al. 1999 for example) and their performance (persistence post stocking, dispersal, and return to the creel) in lakes (Koenig and Meyer 2011), smaller streams or rivers (Dillon et al. 2000, High and Meyer 2009) and tailwaters (Bettinger and Bettoli 2002) and these studies have indicated that triploid fish can provide value as sportfish in these different types of waters. Stocking of triploid trout can be of fingerlings (45 mm [2.75 in]), subcatchables (~ 120 mm [4.75 in]), catchable (200 mm [eight inches]) or larger incentive fish.

Of importance to the potential effects to humpback chub from stocking triploid rainbow trout in the Lees Ferry reach is their capacity to disperse downstream toward the LCR. In considering the potential for dispersal, the movement of the individual fish and its longevity in the habitat play a role in risk assessment. In smaller streams, High and Meyers (2009) discussed past studies that addressed dispersal of rainbow trout in general and documented limited movements of catchable triploids in the Middle Fork Boise River. Trout stocked from June-August and followed through November had median dispersal distances that ranged from 0.10 to five km (up to 3.1 mi) with a maximum of 15.6 km (9.7 mi). The maximum they reported from other literature (Heimer et al. 1985) was 158 km (98 mi) with other significant movements in Bjornn and Mallet (1964) (27.4 km [17 mi]) and 12 km (7.4 mi) (Bettinger and Bettoli 2002), the latter reporting on diploid rainbow trout stocked in the tailwater of Norris Dam on the Clinch River, part of the Tennessee Valley Authority network of dams. One factor mentioned by High and Meyer (2009) and Bettinger and Bettoli (2002) was the influence of high flows on the displacement of recently stocked catchable sized rainbow downstream. In the Middle Fork Boise River, a four week summer high water event occurred immediately after the June stocking and radio-tagged individuals in that period moved further downriver than in July or August. Bettinger and Bettoli (2002) noted that hydropower operations at Norris Dam in September resulted more displacement of stocked trout downstream than under baseflow conditions in July. Both studies documented poor survival of catchable sized rainbow trout (2-6 percent in the Clinch River) which corresponds well with Dillon et al. (2000) showing a 2-3 percent overwinter survival of catchable trout in several Idaho streams and rivers.

The limited persistence time for catchable sized rainbow trout (diploid or triploid) is well documented, and the number of this class of stocked fish that could reach the LCR is very limited.

Survival of stocked fingerlings is higher than for catchable size and they are more likely to overwinter and grow to support the fishery in succeeding years (Bettinger and Bettoli 2002). Stocking of fingerlings to establish or support sport fisheries is common practice and was used to initially establish the Lees Ferry rainbow trout fishery in 1964 and then were stocked annually from 1976 to 1997 (McKinney and Persons 1999). Stocking was halted in part to be able to assess the ability of natural recruitment in the Lees Ferry reach to support the fishery.

As with catchable sized rainbow trout, fingerlings can be mechanically dispersed downstream by increases in flows, particularly before the newly stocked fish can adjust to the new habitat and locate low-velocity refuge areas. Prior to the implementation of modified low fluctuating flows (MLFF), large fluctuations in flows to provide for peaking hydropower were the normal operations of the dam. Fingerling stocking occurred in most seasons with multiple events per year (Persons et al. 1985).

We believe that the intent to restore the Lees Ferry rainbow trout fishery to balanced status as part of the proposed action will help to negate the long-term need for mechanical removal in the LCR reach because in a balanced population, we expect fewer fish will be present in the system to emigrate downstream to the LCR reach from upstream areas. We do not expect any significant effects from the AZGFD management efforts (size and bag limits) for rainbow trout as these are unlikely to have any meaningful effect to the population size of rainbow trout in the Colorado River.

Introduction of triploid rainbow trout may have some adverse effect to humpback chub if they do move out of the stocking reach to 30-mile or below to the LCR. While they cannot reproduce, they are predators and can prey on small humpback chub. Should these triploids be introduced, monitoring of their dispersal would occur and if effects to humpback chub were detected, the program would be re-evaluated. Because it is uncertain if triploids would ever be stocked at Lees Ferry, and the limited number likely to survive to reach the LCR confluence post-stocking, we believe these effects are minor.

Effects to Humpback Chub Critical Habitat

In our analysis of the effects of the action on critical habitat, we consider whether or not the proposed action will result in the destruction or adverse modification of critical habitat. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of critical habitat for the recovery of a listed species (USFWS and National Marine Fisheries Service 1998). To determine this, we analyze whether the proposed action will adversely modify any of those physical or biological features that were the basis for determining the habitat to be critical PCEs. To determine if an action results in an adverse modification of critical habitat, we must also evaluate the current condition of all designated critical habitat units, and the physical and biological features of those units, to determine the overall ability of all designated critical habitat to support recovery. Further, the functional role of each of the affected critical habitat units in recovery must also be defined.

Effects of the Action on the Role of Critical Habitat Reach 7 in Recovery

The Recovery Goals also identify the need to develop and implement levels of control of non-native fish species. The PCEs associated with the biological environment including food supply (B1), and predation from nonnative fish species (B2), may be affected by the nonnative fish removal portions of the proposed action. Predation and competition are normal components of the ecosystem, but are out of balance due to introduced fish species within critical habitat unit Reach 7.

The proposed action continues the removal of spawning brown trout and rainbow trout at Bright Angel Creek to reduce the population of these species in the mainstem that are produced in the creek. Bright Angel Creek is the primary spawning site for brown trout and reductions in both spawning fish and YOY produced will benefit humpback chub. Nonnative removal at the Bright Angel Creek inflow will also reduce brown and rainbow trout populations near that aggregation.

The other nonnative fish components of the proposed action will also benefit the PCEs through continuing removals of nonnatives and monitoring to detect new invasions before they become significant issues.

In summary, the Recovery Goals provide specific criteria for Reach 7 of critical habitat and its PCEs, and implementing the proposed action will support the criteria for removal of nonnative fish.

Effects to Razorback Sucker Critical Habitat

The same benefits as for humpback chub critical habitat will occur for razorback sucker critical habitat.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Cumulative effects to the humpback chub and its critical habitat stem from Native American actions, and State, local, or private actions in tributary watersheds upstream of the action area. Native American use of the Colorado River in Grand Canyon includes cultural, religious, and recreational purposes, as well as land management of tribal lands (e.g. recreational use including rafting, hunting, and fishing). These uses affect humpback chub and its critical habitat and razorback sucker and its critical habitat in similar ways to uses permitted by NPS, although on a much smaller scale thus far, and thus are projected to have minimal effects to humpback chub and its critical habitat or razorback sucker and its critical habitat.

Stone et al. (2007) describes the potential for non-native fishes, including those hosting parasites, to invade the lower LCR from upriver sources 155 miles (250 km) away during certain flood events travelling through the intermittent river segments. Non-native fishes stocked into the area in Arizona utilizing Federal funds have been evaluated, as described above, and are not anticipated to significantly affect humpback chub or its critical habitat or razorback sucker and its critical habitat; however, illegal stocking in the area could result in adverse effects to humpback chub.

Non-Federal actions on the Paria River and Kanab Creek are limited to small developments, private water diversions, and recreation, and are expected to continue to have little effect on humpback chub and its critical habitat. Non-Federal actions in the LCR drainage are extensive, but as discussed in the Environmental Baseline section, these effects have thus far not had a detectable adverse effect on humpback chub and its critical habitat in the LCR, perhaps because these effects are diffuse over a wide area, and are distant from humpback chub and its critical habitat. The draft management plan for the LCR watershed (Valdez and Thomas 2009) provides recommendations to conserve humpback chub in light of these potential effects.

Ongoing land uses around the non-Federal properties are not expected to change during the 20-year period covered by the proposed action, with agricultural uses, urban/suburban development, and recreational uses continuing. There may be increases in uranium mining on state or private lands within the watershed for important tributaries such as Havasu and Kanab creeks.

Climate Considerations for Effects to Humpback Chub and Razorback Sucker

Climatologists predict that the southwest will experience extended drought, so lower Lake Powell Reservoir elevations and warmer release temperatures may be more common over the life the proposed action when compared to historical conditions (Seager et al. 2007, U.S. Climate Change Science Program 2008a, b). Modeling conducted by Reclamation to evaluate the effects of the Interim Guidelines provided predictions of water temperatures below Glen Canyon Dam through 2026. Reclamation utilized 100 years of Colorado River flow data to portray the potential effects of operational changes in wet (90^{th} percentile, i.e. only 10 percent of the 100 years were above the 90^{th} percentile of runoff), average (the 50^{th} percentile), and dry (the 10^{th} percentile). At the confluence of the LCR, during 10th percentile years, the average water temperature near the LCR was predicted to be slightly warmer (less than 0.8ºF [17 ºC]) under the Interim Guidelines in most months. During 50th percentile years, average water temperature near the LCR would also be slightly warmer from April through August. Overall, the predictions were that water temperatures downstream from Glen Canyon Dam would be warmer under the implementation of the Interim Guidelines (USBR 2007).

All activities will occur with the uncertainty surrounding the effects of climate change. The potential for alteration of flows in the basin as a result of climate change could have large impacts on the basin's aquatic ecosystem, including changes in the timing of peak flows from an earlier snowmelt; lower runoff peaks because of reduced snow packs; and higher water temperatures from increased air temperature. Not only would climate change affect the ecology of the species, it also could greatly affect the management of the programs through changes in politics and economics, such as a greater evaporation losses in the larger reservoirs that may reduce flexibility of operations; and drier conditions in the basin that may cause irrigators to call on their water rights more often or request more water rights.

CONCLUSION

This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. We have also relied upon the U.S. Fish and Wildlife Service and National Marine Fisheries Service Consultation handbook (Consultation Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998), which provides guidance on determining adverse modification of critical habitat, including the following (p. 4-34): “Adverse effects on individuals of a species or constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species’ range, or appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species.”

After reviewing the current status of the humpback chub and razorback sucker, the environmental baseline for the action area, the effects of the proposed actions and the cumulative effects, it is the USFWS's biological opinion that the actions, as proposed, are not likely to jeopardize the continued existence of the humpback chub or razorback sucker and are not likely to destroy or adversely modify designated critical habitat for razorback sucker or humpback chub for the following reasons:

- The amount of purposeful take of humpback chub and razorback sucker resulting from the implementation of the CFMP will not have a significant population-level effect on the existing populations of these species in the action area.

- Implementation of the translocations will have an overall benefit to the humpback chub population in Grand Canyon through providing additional spawning and recruitment areas outside of the LCR that can support the existing aggregations.

- The removal of YOY or juveniles from the LCR for use in translocations will not have any significant effect on recruitment to the adult population in the LCR and the adjacent mainstem aggregation.

- Conservation measures included in the proposed action addressing capture and handling protocols reduce the risk of injury or mortality to humpback chub and razorback sucker targeted or incidentally captured during implementation of the CFMP.

- Nonnative fish removal efforts for trout (particularly brown trout) will reduce the populations of those predatory species that will benefit humpback chub through lower predation and competition rates.

- Enhanced nonnative fish monitoring and provision for emergency short-term actions to address new invasions or expanded distribution of existing nonnative fish populations will assist in reducing the risks of these expansions on humpback chub and razorback sucker.

- Implementation of the razorback sucker study will have limited adverse effects on the extant population of razorback sucker in GRCA and provide valuable information to assist in guiding future recovery actions for this species.

- Effects to humpback chub populations from the introduction of triploid rainbow trout are expected to be minor and measures to address any expansion of the triploid population outside of the Lees Ferry fishery are included in the proposed action.

- No adverse effects to water or physical habitat PBFs of humpback chub or razorback sucker critical habitat are expected. Improvements to the biological PBF in relation to a reduction in nonnative fish presence are likely to occur.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by NPS so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. NPS has a continuing duty to regulate the activity covered by this incidental take statement. If NPS (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NPS must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Humpback Chub

Incidental take of humpback chub will occur as a result of fish capture and handling actions undertaken by NPS under the CFMP. This take will be in the form of harassment from capture and handling of all individuals incidentally taken while pursuing other species and in the event of injury or mortality of individuals as a result of any capture or handling event.

Based on the results of past survey and monitoring efforts for humpback chub by NPS, we anticipate that future incidental take of adults, sub-adults, and juvenile humpback chub will be consistent with levels seen in the past even with the increase in capture and handling of these size classes due to additional projects included in the CFMP. As documented in Table 5, losses of humpback chub due to activities similar to those included in the CFMP are very low. In implementing ongoing projects such as the Shinumo and Havasu creeks translocations, NPS has not documented any incidental mortality of humpback chub from capture or handling (see Table 5). However, we know that some level of incidental take is likely to occur in any year even if we cannot anticipate the level of that take.

Based on past reported take levels, we anticipate incidental take of humpback chub will occur and that the amount of such take is dependent on the size of the individual at capture. As discussed in the effects of the action section, very small fish are more likely to be inadvertently injured or killed during collection efforts than are larger fish even under the most careful collection protocols. Larger fish are still at risk but at a reduced rate.

Incidental take is anticipated to be no more than (annually):

- Individuals from 31-100 mm = five percent of the total number captured
- Individuals from 101-200 mm = one percent of the total number captured
- Individuals over 201 mm = no more than five individuals regardless of the total number captured.

Razorback Sucker

Incidental take of razorback sucker will occur as a result of fish capture and handling actions undertaken by GRCA under the CFMP. This take will be in the form of harassment from capture and handling of all individuals incidentally taken while pursuing other species and in the event of injury or mortality of individuals as a result of any capture or handling event.

Our only reference to razorback sucker injury or mortality is from work done on the lower Colorado River (Lake Mead to the Southerly International Boundary) done under the LCR MSCP and earlier projects led by Reclamation. As discussed under the effects of the action section, rates of injury or mortality from the use of trammel nets and electrofishing on juveniles, sub-adults, and adults are very low.

Most of the razorback sucker captured under this project will be YOY less than 25 mm (~one in) and up to 5,000 will be purposefully taken for analysis. Sonic-tagged adult razorbacks and any wild razorbacks will be targeted for capture and released and based on past surveys, large numbers of these fish are unlikely to be present in the canyon.

Incidental take is anticipated to be no more than (annually):

- Individuals less than 30 mm = five percent of the total number captured
- Individuals 31-100 mm = five percent of the total number captured
- Individuals from 101-300 mm = one percent of the total number captured
- Individuals over 300 mm = no more than two individuals regardless of the total number captured.

EFFECT OF THE TAKE

In this biological opinion, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The proposed action includes collection and handling requirements that are designed to reduce the risk of injury or death to humpback chub and razorback sucker from collection and handling actions. As these are already included, they are not re-stated here. Except as described below, no additional reasonable and prudent measures or terms and conditions have been identified for this project.

Implementation of the ongoing Shinumo Creek translocation and rainbow trout removal/monitoring has revealed some issues with the existing restrictions on electrofishing in the creek that may also affect future work in Bright Angel Creek should humpback chub be translocated there. Those restrictions (as included in the NPS' section 10(a)(1)(A) permit) read:

1. Nonnative fish collection and monitoring actions will be implemented to reduce risk of capture or injury to humpback chub.

    - Operation of the fish weir will include daily monitoring to check for humpback chub in the holding area. Any captured humpback chub will be processed and released upstream of the weir.

    - Electrofishing is not authorized in areas where humpback chub have been translocated However, if humpback chub are encountered during electrofishing, either during nonnative fish removal efforts or during presence/absence surveys, the following criteria will be employed:

a. At least one night of hoopnetting will occur to determine presence/absence of humpback chub in areas to be electrofished. If more than five humpback chub are captured, no electrofishing will occur.

b. Any humpback chub captured during electrofishing passes will be transported out of the reach and downstream of the block nets to avoid a second capture.

c. Electrofishing will cease for that sampling event if more than 10% of translocated humpback chub are captured.

In response to NPS concerns about the existing restrictions, USFWS will use the following revised restrictions in future section 10(a)(1)(A) permits replaces them with the following:

Targeted surveys for humpback chub using electrofishing is not authorized in the tributaries or the mainstem of the LCR. However, if humpback chub are encountered during electrofishing either during routine or short-term emergency removal efforts for nonnative fish or during presence/absence surveys in the mainstem or tributaries, the following criteria will be employed:

A. Electrofishing protocols in Persons et al. (2013) (or subsequent editions thereof) will be strictly followed to reduce the risk of death or injury to the individual humpback chub.

1. Electrofishing gear will be set to avoid injury to native fish, and crews will be appropriately trained on the use of the equipment.
2. In tributaries where humpback chub have been released, use of electrofishing equipment will be minimized in large-volume, deep pools where this gear is less effective in capturing fish, and where humpback chub tend to congregate.
3. Block nets will be used during multiple-pass depletion electrofishing in tributaries 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.
4. 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.
5. Fish captured using electrofishing will be monitored in buckets, and gear settings would be adjusted if sufficient recovery is not observed within a few minutes.
6. Netters and electrodes will be positioned so that fish can be removed from electrical fields as quickly as possible.
7. During sampling efforts, all native fish will be processed first and handling time on captured humpback chub will be minimized whenever possible.

B. Other measures to be implemented are.

1. Electrofishing would be restricted for at least six months following translocations to allow translocated fish to fully acclimate to the new environment.

2. Electrofishing would not occur in the spring/early summer months to avoid interfering with native fish spawning periods.
3. Electrofishing to monitor and remove trout populations would occur no more than once per year in translocation streams.
4. Electrofishing will cease for that sampling event if more than 10 percent of the captured humpback chub are injured or die while being held for processing post-capture.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the USFWS's Office of Law Enforcement, (Resident Agent in Charge), 4901 Paseo del Norte NE, Suite D, Albuquerque, New Mexico 87113, telephone: 505-248-7889 within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Office of Law Enforcement with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The USFWS has not identified any additional conservation recommendations for this proposed action.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the Project Description of this Opinion. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of GRCA’s action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

In keeping with our trust responsibilities to American Indian Tribes, we encourage you to continue to coordinate with the Bureau of Indian Affairs in the implementation of this consultation and, by copy of this biological opinion, are notifying the following Tribes of its completion: the Southern Paiute Consortium, Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Navajo Nation, Pueblo of Zuni, and San Juan Southern Paiute Tribe. We also encourage you to continue to coordinate with AZGFD.

We appreciate the NPS' efforts to identify and minimize effects to listed species from this project. For further information please contact Lesley Fitzpatrick (602-242-0210 ext. 236) or Steve Spangle (ext. 244). Please refer to the consultation number 02EAAZ00-2012-F-0252, in future correspondence concerning this project.

/s/ Steven L. Spangle

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (ARD-ES, ARD-FARC)
Project Coordinator, Arizona Fish and Wildlife Conservation Office, Flagstaff, AZ

Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Director, Environmental Programs, Bureau of Indian Affairs, Phoenix, AZ
Honorable Chairman, Havasupai Tribe, Supai, AZ
Honorable Chairman, Hopi Tribe, Kykotsmovi, AZ
Honorable Chairwoman, Hualapai Tribe, Peach Springs, AZ
Honorable Chairperson, Kaibab Band of Paiute Indians, Pipe Springs, AZ
Honorable President, Navajo Nation, Window Rock, AZ
Honorable Governor, Pueblo of Zuni, Zuni, NM
Honorable President, San Juan Southern Paiute Tribe, Tuba City, AZ
Southern Paiute Consortium, Fredonia, AZ

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APPENDIX A: CONCURRENCES

California Condor

Status and Background

The California condor was listed as an endangered species in 1967 (USFWS 1967 (32 FR 4001, March 11, 1967). 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).

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 GRCA 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. Cliffs, tall conifers, and snags serve as roost sites (USFWS 1996a).

GRCA Distribution and Population Status

As of October 2012, the population of wild condors in Arizona is 77. 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. Nesting sites are concentrated in three areas of the canyon; upper Marble Canyon, along the South Rim (Dana Butte, Battleship, Salt Creek, Grandeur Point) and the Deer/Tapeats/Thunder River area. Based on GPS location point data, condors have been documented flying, perching, and nesting throughout GRCA with concentrations of activity at the South Rim and Marble Canyon areas. Condors are highly active year-long at the South Rim and Marble Canyon. A growing number of condors typically begin visiting the Marble Canyon portion of the Colorado River corridor in February, March, and April (NPS 2005a). Condors are at rim level less frequently in winter and usually are seen along the river corridor and Phantom Ranch outside of the summer months.

The breeding season for condors in GRCA is from February 1 to September 30, although courtship is initiated in December. 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.

As noted above, California condor nesting and roosting habitat is generally limited to cliffs and caves in the inner canyon and not concentrated in the river corridor. Condors use the river corridor, particularly near Phantom Ranch, outside of the summer period. The activities of the proposed CFMP will take place along the mainstem Colorado River and in tributaries within GRCA at different times of the year based on the particular project.

Conservation Measures for California Condor

The proposed action contains a set of conservation measures to reduce the potential for effects to condors from the proposed action:

- 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 GRCA Wildlife Department
- Avoid any condors that arrive at any area of human activity associated with fish management activities. Notify GRCA 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
- GRCA 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 GRCA’s Wildlife Department.

Analysis and Determination of Effects

Implementation of the proposed action will result in situations where condors may be attracted to project areas during fisheries management activities. The effects of groups of personnel with boats and other equipment as an attractant to condors and additional noise disturbance away from the river corridor but within the canyon from helicopter flights in and out of the canyon transporting live fish, staff, and project equipment are the areas of concern.

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 engaged in diurnal activities. In the tributaries (Bright Angel, Havasu, LCR, and Shinumo) electrofishing, netting, and other monitoring actions occur during the day within the tributary canyon. Scheduled trips to all but Bright Angel also occur in the early to late summer period (May through September) when condors are less likely to be lower in the canyon near the river. The ongoing nonnative fish removal at Bright Angel Creek occurs between October and March when condors may frequent the area.

Helicopters would be utilized for transporting live fish, staff, and project equipment to various locations in the inner canyon. Helicopters are used at Bright Angel and Havasu creeks to transport equipment and at Havasu and Shinumo for translocation events in May or June. If translocations are eventually approved for Bright Angel Creek, one additional helicopter trip per year would be required. There is potential for direct noise disturbance to condors from helicopter trips. The conservation measures work to minimize the potential for noise disturbance.

Boat trips to Shinumo occur in summer and early fall and leave from Lees Ferry. Shinumo Creek is between the Deer/Tapeats breeding area and the South Rim breeding area. The timing of the Shinumo trips reduces the opportunity for interactions with condors as they take place during the part of the year condors are not using the river corridor

Night-time operations for mainstem electrofishing are unlikely to have any effect on condors; although the boats and campsites for the day may attract attention. GRCA mainstem activities will occur from late spring to early fall and avoid the higher condor use period in winter.

Field crews that hike into or out of the canyon may also come into contact with condors. Crews may also need to travel through nesting or roosting 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. Conservation measures to educate work crews of condor concerns and to cease activities if condors are present would reduce potential disturbance from management activities on the birds. To date, condors have not been observed near NPS fisheries projects.

<u>Conclusion</u>

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

Mexican Spotted Owl

Status and Background

The Mexican spotted owl (MSO) was listed as a threatened species in 1993 (USFWS 1993, 58 FR 14248, March 16, 1993) and portions of GRCA were designated as critical habitat in 2004 (USFWS 2004b, 69 FR 53182, August 31, 2004). A Recovery Plan was published in December 1995 with new final plan released in December, 2012 (USFWS 2012). In the Plan Revision, Recovery Units have been renamed as "Ecological Management Units" (EMU); GRCA is located within the Colorado Plateau EMU.

MSOs are known to occur in Arizona, New Mexico, southern Utah, portions of 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 M`adrean woodland, and sandstone canyonlands (USFWS, 1995a).

Nest and roost sites of MSO are primarily in closed-canopy forests or rocky canyons. Breeding occurs between March and August annually. 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, encompass about 600 acres surrounding known owl sites and are intended to protect the activity center of a single owl territory (USFWS 2012).

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 GRCA defined as low thermal intensity, short thermal duration, and steep slopes (Spotskey and Willey 2000).

GRCA Distribution and Population Status

GRCA MSO presence was confirmed in 1992 through field surveys. To understand the distribution and abundance of spotted owls in Grand Canyon, the park initiated inventory for spotted owls within both forest and rocky canyon habitats in the mid-1990s. 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). 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). 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).

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 GRCA Wildlife Department if MSO are discovered during any projects
- As resources allow, GRCA 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
- Consult GRCA Wildlife Department prior to conducting planned fisheries management activities
- 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, GRCA'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, GRCA'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.

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. Work on the river and the lower portions of tributaries during the daylight hours have the potential to create noise disturbance to MSO nearby. While that level of disturbance is likely low, of greater concern are the helicopter flights carrying live fish, staff, and project equipment from the rim into the canyon.

Research on the potential for human disturbance on 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 (2007), 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 Grand Canyon'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); negative effects may occur to birds not habituated to these impacts (Bowden et al. 2010).

The number of helicopter flights associated with the proposed action is less than 10 per year and the flights occur once or twice a year at Bright Angel, Havasu, and Shinumo creeks.

Conclusion

Based on implementing the conservation measures, the distance helicopters and work crews would maintain from known roost/nest sites, and the short-term duration of noise the USFWS concludes that the proposed actions ***may affect, but is not likely to adversely affect*** the Mexican spotted owl.

The CFMP does not propose any activities on the North Rim of GRCA or activities that would alter inner canyon critical habitat and therefore the USFWS determines ***no effect*** to designated MSO critical habitat.

SOUTHWESTERN WILLOW FLYCATCHER

Status and Background

The southwestern willow flycatcher (SWWF) was listed as an endangered species in 1995., the southwestern willow flycatcher was designated as endangered (USFWS 1995b, FR 60 10694 March 29, 199) in its entire range, which is known to include Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico. Critical habitat was designated in 2013; however, there is no critical habitat in the action area.

The Southwestern Willow Flycatcher Recovery Plan (USFWS 2002) establishes six recovery units that are further subdivided into management units. GRCA falls 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 2002).

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. Nesting begins in late May and early June and young fledge from late June through mid-August. The entire breeding cycle, from egg laying to fledging, is approximately 28 days (USFWS 2002). Nesting occurs during the spring and early summer months (May 1st through August 31st) in the GRCA.

Historical egg/nest collections and species descriptions throughout its range identify the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting. Other habitats are also used, including non-native species such as tamarisk (saltcedar; *Tamarix spp.*), and Russian olive (*Eleagnus angustifolia*) (USFWS 2002). 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.

GRCA Distribution and Population Status

Seventeen flycatcher sites were identified in the 2002 Recovery Plan (USFWS 2002) within the park. Flycatcher territories in GRCA 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. Historic and recent nesting site locations in GRCA have been documented below Lees Ferry in Marble Canyon and in the lower gorge below Diamond Creek. 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. Within GRCA, this is especially noticeable in the lower gorge where dropping lake levels in Lake Mead have resulted in high walls (approximately 3.3 to 6.6 meters [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 difficult to find.

Numbers of southwestern willow flycatcher detections in GRCA have declined since the 1980's. 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 GRCA (Sogge et al. 1997). From 2004 to 2008, only two southwestern willow flycatchers were detected between Lees Ferry and Phantom Ranch. Although surveys were conducted in 2012, southwestern willow flycatchers were not detected.

Summary: 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 50.5-51.5, but have not been present since 2004 (Ward and Haynes 2007, Northrip et al. 2008). In 2003, 2004, and 2010 the area around RM 28-29 was occupied. In 2004, GRCA 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 RM 28.1-28.5, river left and RM 50.2-50.6, river left. Closures at RM 28 and RM 50 have been put in place intermittently in the past; closure at Cardenas (RM 71) was instituted in the early and mid-1990s.

Summary: Lower Gorge
Southwestern willow flycatchers have been regularly detected in the lower gorge (RM 234 - RM 277) since 1995 with the exception of 2002, 2003, 2011, and 2012. In 2004, Koronkiewicz identified approximately 76 hectares of suitable habitat within the lower gorge of GRCA at several sites between RM 239 and 275. 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 later may rank the site as only potential habitat.

<u>Conservation Measures for Southwestern Willow Flycatcher</u>

- 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. 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
- Contingent upon availability of funding, GRCA 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

<u>Analysis and Determination of Effects</u>

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. Primary work areas for the CFMP do not include recently occupied SWWF habitats in the Lees Ferry to Diamond Creek reach. New efforts for razorback sucker in the Lower Gorge will add six trips per year to the two done by GCMRC. 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 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 but could impact some shoreline vegetation (trampling) and cause some noise disturbance. The conservation measures proposed will limit the amount of potential disturbance.

Conclusion

Based on implementing the conservation measures, the limited area that could be affected by human access, and the short-term duration of noise the USFWS concludes that the proposed action ***may affect, but is not likely to adversely affect*** the southwestern willow flycatcher.

Yuma Clapper Rail

Status and Background

The Yuma clapper rail (YCR) was listed as endangered in 1967 (USFWS 1967 (32 FR 4001, March 11, 1967). A five year review of the species was completed in 2006 (USFWS 2006) and currently the 1983 recovery plan is in the revision process (USFWS 2010). The YCR 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 2010). Between 2000 and 2008 the number of YCR in the United States has fluctuated between 503 and 890 (USFWS 2010).

The YCR 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. 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). 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. YCR are not migratory and are present in the habitat all year. Breeding occurs from March to early July (USFWS 2010).

GRCA Distribution and Population Status

Yuma clapper rails have been recorded at GRCA between 1996 and 2001, however, information about the clapper rail and its habitat in the lower gorge is extremely limited and surveys have not been conducted in the park in recent years.

McKernan and Braden (1999) report the presence of Yuma clapper rails between Spencer (RM 246) and the boundary of GRCA (RM 277) in 1996 and 1997; these observations were made while conducting southwestern willow flycatcher surveys in the area. YCR were also observed in 1999 and 2000 near RM 275 and 276. In 2001, three individual Yuma clapper rails were observed in the vicinity of Burnt Springs (RM 259.8) by San Bernardino College (Leslie 2002).

Habitat is present in a very limited quantity within the lower gorge in GRCA. 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 GRCA boundary. It is not known if such habitat is present in sufficient quantity to allow for nesting.

Conservation Measures for the Yuma clapper rail

- As funding allows, GRCA will conduct surveys for the Yuma clapper rail in the lower gorge (RM 234 – RM 277). 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 GRCA during the breeding season or if nests are located, GRCA will establish a closure of suitable breeding habitat in the area, with an appropriate buffer, during the length of the breeding season (March 1-July 1).
- Occupied clapper rail habitat would be avoided during the breeding season
- 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

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, suitable and existing breeding areas. The six new trips below Diamond Creek that are part of the proposed action increase the amount of human disturbance in the area. YCR are seldom seen in the wild, preferring to hide in the cattails or other vegetation. They also become used to normal noise levels (USFWS 2010) in their environment. 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 but could impact some shoreline vegetation (trampling) and cause some noise disturbance.

Conclusion

Based on implementing the conservation measures, the limited area that could be affected by human access, and the short-term duration of noise the USFWS concludes that the proposed action ***may affect, but is not likely to adversely affect*** the Yuma clapper rail.

Western Yellow-Billed Cuckoo

Status and Background

The western yellow billed cuckoo (YBC) is a candidate species for listing under the ESA USFWS 2001). The YBC is a neotropical migrant that breeds throughout northern Mexico, the United States and southern Canada (Hughes 1999). Western yellow-billed cuckoo populations have declined significantly (Hughes 1999, 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 take place 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). Cuckoos have the shortest nesting cycle among birds, a minimum of 16 days between egg and fledging (Payne 2005)

GRCA Distribution and Population Status

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, Havasu Canyon, and 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 Burnt Springs by San Bernardino College (pers. comm. San Bernardino College to Elaine Leslie, 2001). While a portion of GRCA 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 very limited within the lower gorge of GRCA. Based upon detections prior to 1998, suitable nesting habitat may also be present within the upper portion of the project area, however, surveys have been extremely limited to date within the lower gorge and non-existent in the upper river corridor, and their failure to detect nesting cuckoos does not indicate definitively that the species is not present within the project area.

Conservation Measures for western yellow-billed cuckoo

- Occupied western yellow-billed cuckoo habitat would be avoided during the breeding season (June to August)
- Prior to the start of any fisheries management activities, GRCA's wildlife department would be contacted for any new information related to cuckoos, cuckoo habitat, and their status near the project area.
- As funding allows, GRCA would conduct surveys for the western yellow-billed cuckoo in the lower gorge (RM 234 – RM 277). 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.
- Habitat modification of riparian areas would not occur as part of fisheries management activities.

Analysis and Determination of Effects

Impacts to the YBC 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, cuckoos may be disturbed due to increased human-generated noise during the breeding season. YBC often display avoidance behavior or avoid moving when humans are observed, particularly during the breeding season (Halterman 2010, Luneau 2002). Telemetry observations in 2009 and 2010 show many cuckoos detected are transitory and do not stay on-site long (McNeil et. al 2010).

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.

Conclusion

Based on implementing the conservation measures, the limited area that could be affected by human access, and the short-term duration of noise the USFWS concludes that the proposed action ***may impact individuals but is not likely to jeopardize the continued existence of the western yellow-billed cuckoo***.

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APPENDIX B: Allocation of Purposeful and Incidental Take

This BO provides the effect analysis for the purposeful take to be provided under the section 10(a)(1)(A) recovery permit issued by the USFWS to NPS, and for the incidental take resulting from the implementation of the proposed action that is provided in the incidental take statement (ITS) included with this BO. The USFWS will continue to issue NPS their section 10(a)(1)(A) permit annually or on a schedule agreed to by both parties. The ITS included with the BO provides annual incidental take levels for the life of the proposed action (20 years). Reinitiation of consultation would be required relative to incidental take only if the amount of incidental take was exceeded in any year.

Purposeful take results from deliberate actions under the CFMP to capture wild humpback chub and razorback sucker in the Colorado River and Little Colorado River to implement the CFMP. Capture of individuals as part of targeted surveys for that species and subsequent handling (which includes temporary holding for processing, collection of weight and length data, fin clipping for genetic research, insertion of PIT tags or other markers to subsequently identify individuals recaptured later) and release back into the wild is considered purposeful take. Capture and removal from the wild of individual humpback chub and razorback sucker for subsequent rearing prior to repatriation or for specific research purposes where there is no return to the wild are also considered purposeful take. Purposeful take can have numerical limits for some actions (permanent or temporary removals from the wild) and be unlimited for other actions (surveys and monitoring actions) depending on the effects to the population from the take.

Incidental take results from two primary sources; (1) inadvertent or accidental encounters with humpback chub or razorback sucker while implementing actions under the CFMP that are not targeted to these species; or (2) where injury or mortality to individual humpback chub or razorback sucker results from either targeted or non-targeted actions under the CFMP. For example under (1), humpback chub or razorback sucker encountered during brown or rainbow trout removal actions are incidentally taken and are considered harassed. Under (2), if any captured humpback chub or razorback sucker are unintentionally injured or killed as a result of any capture event (targeted or non-targeted), these individuals are also considered harassed. Because incidental take is not intentional and under the best of circumstances should not occur, limits are usually put on the number of individuals injured or killed as a result of implementation of the proposed actions. Reasonable and prudent measures with implementing terms and conditions to reduce the risk of incidental take occurring are also part of the ITS.

NPS already holds a section 10(a)(1)(A) permit that covers purposeful and incidental take for their current activities for humpback chub and razorback sucker. Currently, there is no incidental take authorized through an incidental take statement that is part of a biological opinion for a specific project (the Bright Angel Creek BO expired in 2012). Under the proposed action, additional purposeful and incidental take coverage will be needed for both species. Tables 1 and 2 list the projects and methods to be used for the species and what type of take will be authorized through the permit and the incidental take statement.

Table 1: Humpback chub take (annual)

PROJECT	METHODS	10(a)(1)(A) Permit (Purposeful Take)	Biological Opinion ITS
Translocations of HBC	Transport to stocking site; Placement in translocation stream	Up to 600/stream/yr	Yes
HBC larval capture in mainstem[2]	Seines	N/A	Yes
PIT tagging	Persons et al. 2013	Unlimited	Yes
Handling	Persons et al. 2013	Unlimited	Yes
Bright Angel trout removal (pre-HBC introduction) Post-HBC introduction trout removal in Bright Angel Creek	Operation of weir; Instream electrofishing; Mainstem electrofishing Operation of weir; Instream electrofishing; Mainstem electrofishing Hoopnets; Minnow traps; Seining; Angling;	N/A[3] N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A Yes Yes Yes Yes Yes Yes Yes Yes
Bright Angel HBC monitoring	Baited hoopnets Baited minnow traps Handling (Persons et al. 2013)	Unlimited Unlimited Unlimited	Yes Yes Yes
Shinumo Creek trout removal	Instream electrofishing Hoopnets Minnow traps Seining Angling	N/A N/A N/A N/A N/A	Yes Yes Yes Yes Yes
Shinumo Creek HBC monitoring	Baited hoopnets (creek and mainstem Mainstem trammel nets Baited minnow traps Handling (Persons et al. 2013)	Unlimited Unlimited Unlimited Unlimited	Yes Yes Yes Yes
Havasu Creek nonnative removal	Mainstem electrofishing Hoopnets Minnow traps Seining Angling	N/A N/A N/A N/A N/A	Yes Yes Yes Yes Yes
Havasu Creek HBC monitoring	Baited hoopnets Baited minnow traps Handling (Persons et al. 2013)	Unlimited Unlimited Unlimited	Yes Yes Yes

[2] These humpback chub may be inadvertently collected along with razorback sucker larvae below Lava Falls. This number is not in addition to that already permitted for incidental take under other permits for the razorback sucker project. If the razorback sucker project does not move forward, this incidental take would not occur.

[3] N/A in any box means that there is no purposeful and/or incidental take associated with that activity to be addressed for NPS personnel.

Table 2: Razorback sucker take

PROJECT	METHODS	10(a)(1)(A) Permit (Purposeful Take)	Biological Opinion ITS
Below Lava Falls fish community monitoring	Mainstem electrofishing Trammel nets Hoopnets Minnow traps Seines	Unlimited Unlimited Unlimited Unlimited Unlimited	Yes Yes Yes Yes Yes
Handling	Persons et al. 2013	Unlimited	Yes
RBS larval collections	Seines	Up to 5,000/year for three years[4]	Yes
RBS sonic tagging[5]		N/A	N/A
RBS pit tagging	Persons et al. 2013	Unlimited	Yes
RBS long term monitoring	Nets	Unlimited	Yes
RBS augmentation[6]	Transport and stocking to river	To be determined	

[4] NPS may assist other permitted researchers in collecting these larvae. This 5,000 is not in addition to that authorized under other permits. Unless this project is funded, no larval collection is anticipated
[5] As currently planned, NPS will not be the lead agency for implanting sonic tags into razorback sucker. Personnel from NPS may be present at the time the work is done.
[6] Additional compliance will be needed to address any augmentation program for razorback sucker. The analysis of purposeful and incidental take will be made in a subsequent biological opinion.

APPENDIX C: Tables and Figures

Table 1. Comparison of current conditions and proposed modifications of the preferred alternative for the Comprehensive Fisheries Management Plan, Grand Canyon National Park (From NPS 2013)

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

Table 2: Project element descriptions from GCMRC budget 2013-14

Project Element	Trip Details	Location of Work	Capture Methods Used	Handling
D.1 Improve aggregation sampling	July and Sept, 14 days each 8 aggregation sites, 14 random Maximum 2-3 nights per site/yr	RM 29-214	Trammel net Baited hoopnet	General handling PIT tagging
D.2 Natal origins HBC, adult conditions and reproductive potential	Unclear, may be part of July trip or other	RM 29-214	Trammel net Baited hoopnet	Additional handling to evaluate gamete development.
D. 2.1 Natal origins otolith evaluation	Trip to collect 30-40 yoy per site for lab evaluation. Two year project.	Random and up to 3 aggregations/yr, and LCR	Seine	Specimens preserved for laboratory analysis
D. 2.2 Egg maturation	Trips to LCR and aggregations at different times of year. 3-4 year project	Initially LCR (FY13), then Up to 3 aggregations/year	Baited hoopnets (except at LCR)	General handling PIT tagging Ultrasound readings Holding in net pens Handling to expel eggs
E. 1 LCR marking juvenile HBC in LCR	One trip/year in July	The 3 LCR camps of USFWS	Hoopnets (unbaited) Seines	General handling PIT tag or VIE mark
E. 2 Food web structure in LCR	June and October. Collect invertebrates, detritus, and other food materials.	LCR	Hoopnets (unbaited) Seines Invertebrate sampling tools Organic matter sampling tools	General handling Gastric lavage Fin clip Risk of trampling during instream collection efforts
E. 3 Population modeling	None specific, uses E. 1 and other surveys to locate marked fish to put into model.			
F. 1 System wide electrofishing	Two trips, April and May One trip below Diamond Creek in October	Lees Ferry to Lake Mead	Electrofishing	General handling PIT tagging

F. 2.1 Rainbow trout monitoring Glen Canyon	March, July, and October	Lees Ferry Reach	Electrofishing	Not likely to encounter listed species
F. 2.2 Rainbow trout early life stages	Redd surveys December –May Juvenile surveys July-September	Lees Ferry Reach	Visual?	Not likely to encounter listed species
F. 3 Juvenile chub monitoring	January, April, June, September, 20 day trips each	LCR Inflow Area	See NSE methods	General handling PIT tagging
F. 4.1 USFWS LCR monitoring	April, May, September, October 11 days each	LCR lower 13.6km	Hoop nets (unbaited)	General handling PIT tagging
F. 4.2 AZGFD LCR monitoring	April-May, 40 days	LCR lower 1.2km	Hoop nets (unbaited)	General handling PIT tagging
F. 4.3 USFWS Chute Falls	June monitoring July translocation	LCR lower 13.6km LCR above Chute Falls	Hoop nets (unbaited) Seines?	General handling PIT tagging Capture and transport
F. 4.4 PIT tag antenna array	Array is in place Maintenance may be needed (in water and on shore	LCR 2 km above confluence	None	None unless in-water maintenance needed. (Trampling)
F. 5 ASMR	Uses data from other sources			
F. 6 Rainbow trout natal origins	Marking trip(s) at Lees Ferry in October-November Survey trips to LCR inflow combined with F.3	Lees Ferry reach LCR Inflow	Electrofishing	Not likely to encounter listed species See F.3
F. 7.1 Invertebrate drift	Year round with surveys every 6 weeks Emergent/terrestrial insect survey	Glen Canyon Diamond Creek	Invertebrate drift nets set in water column for 5 minutes Light traps, sticky traps	No capture of listed fish
F. 7.2 Citizen science	April-October: Equip up to 10 river guides on commercial river trips to survey for emergent/terrestrial insects	River wide	Light traps on land	No capture of listed fish
F.7.3 Primary productivity	Continuously monitor algal production	Glen Canyon and RMs 30, 61, 87, and 225	?	?

F.7.4 Benthic algae and invertebrate biomass	One trip in spring to sample all habitat types. Probably associated with another river trip	Throughout river	Standard benthic sampling	No capture of listed fish
G. 1 Effects trout predation and competition on HBC	Laboratory work only Requires captive reared HBC larvae from Dexter			Mortality of captive bred fish from experiments
G.2 Trout removal in Bright Angel Creek inflow area	September and April	Colorado River RM 85-90	Electrofishing for trout may also capture humpback chub	Exposure to electric field Handling PIT tagging
H. 1 Feeding studies on rainbow trout	Laboratory work only			No native fish involved in study
H. 2.1 Model for primary productivity	Scuba diving to place and evaluate algal growth	Glen Canyon Diamond Creek	Placement of artificial substrates on underwater cliffs at various depths	No native fish involved in the study. Some disturbance possible
H. 2.2 Characterize invertebrate drift	Combine with HBC aggregations/otolith trips		Invertebrate drift nets set during day over 2 days	No capture of listed fish
H. 3 Bioenergetics model for large RBT	Information provided by H.2.2, D.2.1			No effects to listed fish
H. 4 Tailwater synthesis	Literature survey and synthesis			No effects to listed fish

Table 3: River trips associated with project elements potentially affecting humpback chub or razorback sucker (based on 2012 and 2013 GCMRC schedules which are subject to change).

Project Element/ Agency/ Location	Rainbow trout redd survey GCMRC Lees Ferry Reach		Rainbow trout population monitoring AZGFD Lees Ferry Reach		Rainbow trout early life history GCMRC Lees Ferry Reach		Mainstem survey AZGFD RM 0 to 225 in April & May, 225-279 in Oct		Natal origins RBT/Juvenile HBC Ecometric/ GCMRC Lees Ferry Reach/LCR inflow		HBC aggregations FWS/GCMRC RM 0 to 225		Grand Canyon Youth GCMRC RM 0 to 225, opportunistic seining		Humpback chub in LCR FWS/GCMRC/ CSU LCR	
FiscalYear	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
October			1	1				1		1					1	1
November					1	1			1							
December	1	1														
January	1	1								1						
February	2	2														
March	2	2		1												
April	1	1	1					1	1	1					2	2
May	1	1					1	1							2	2
June										1				1	1	3
July			1	1	1	1			1			1	1		2	1
August					1	1										
September					1	1			1	1	1	1			1	1
Total	8	8	3	3	4	4	1	3	4	4	1	2	1	1	9	10

Table 4: GRCA River and Tributary Trips 2012-2013 and with proposed action

Location	**Project Name**	**Techniques Used**	**2012**	**2013**	**With PA**
Mainstem	Shinumo Inflow Aggregation Monitoring	netting (hoop nets)	1	2	2
	Bright Angel Creek Inflow Nonnative Removal	electrofishing	0	0	1
	Marble Canyon Trout Removal	angling	0	0	2-4
	Razorback Sucker Sonic Telemetry and lower GRCA Nonnative Fish Monitoring	radio tracking netting (seines)	0	0	6
Tributaries	Shinumo Creek monitoring	electrofishing/netting	2/1	1/2	1/2
	Havasu Creek monitoring	netting	2	2	2
	Kanab Creek Nonnative monitoring	electrofishing/netting	0	2	2
	Bright Angel Creek Nonnative Removal	electrofishing	1	1	1
TOTAL TRIPS			8	9	19-21

Notes:

1. This is the average number of trips excluding emergency responses
2. Razorback sucker trips would not always include sampling/handling of fish.

Table 5: Incidental take reporting 2008-2012

Table 5a: USFWS data for LCR (hoopnets and PIT tagging) and mainstem aggregations (hoopnets, trammel nets, and PIT tagging) for all size classes (Pillow 2013)

Year	Total handled	Total mortalities	Percent mortalities
2008	7333	2	0.03
2009	8327	7	0.08
2010	6762	11	0.16
2011	7790	12	0.15
2012	13462	64	0.48
Average			0.22

Table 5b: GCRMC data for Near Shore Ecology study (primarily YOY and juvenile size classes) compiled by USFWS for 2009-2011 (Pillow 2013) and GCMRC for 2012 (VanderKooi 2012)

Year	Total handled	Total mortalities	Percent mortalities
2009	3199	12	0.37
2010	4035	38	0.94
2011	5530	27	0.48
2012	7755	22	0.28
Average			0.51

Table 5c: Capture device mortalities for 2012 for GCMRC (VanderKooi 2012)

Mainstem electrofishing: 14
Mainstem hoop netting: 8
LCR netting: 4

Table 5d: GRCA 2011 captures of humpback chub by stream and gear type (Rogers 2012). Includes purposeful and incidental captures. No mortalities were reported.

	Electro-fishing	Hoop net	Minnow trap	Seine	Angling	Trammel net
Shinumo						
June	0	46	5	3	0	N/A
September	2	223	4	2	3	N/A
Total	2	269	9	5	3	N/A
Havasu						
June	N/A	7	0	N/A	N/A	2
October	N/A	109	0	N/A	N/A	N/A
Total	N/A	116	0	N/A	N/A	2