Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 22-23, 2012

Agenda Item

Technical Work Group Chair Report – Part 2

Action Requested

✓ This is an information item.

Presenters

Shane Capron, Technical Work Group Chair, Western Area Power Administration

Previous Action Taken

N/A

Relevant Science

N/A

Background Information

Update on Fish Management Flows

The need for the AMP to develop nonnative fish management flows and other actions was described in the nonnative fish control EA and in the 2011 biological opinion as a reasonable and prudent measure and term and condition for humpback chub take. The biological opinion reads as follows:

> Reclamation has committed to develop, with GCDAMP and stakeholder involvement, additional non-native fish control options during the first two years of the proposed action to reduce recruitment of non-native rainbow trout at, and emigration of those fish from, Lees Ferry. Reclamation will coordinate the development of these actions with the on-going NPS Management Plan for native and non-native fish downriver of Glen Canyon Dam in both the GCNRA and GCNP. Both flow and non-flow experiments focused on the Lees Ferry reach may be conducted in order to experiment with actions that would reduce the recruitment of trout in Lees Ferry, lowering emigration of trout. Additional environmental compliance may be necessary for implementation of the following types of experiments that will be considered. . . . (page 108 of the biological opinion)

A number of stakeholders have been working with various scientists and agencies to tier off earlier efforts (paper developed by Valdez et al 2010) and to develop a proposed management plan. Western Area Power Administration (Western) has been helping to coordinate that effort and provide support. Western presented the latest draft of that effort (the flow options paper attached) to the TWG. The TWG had a robust debate on next steps and the need to coordinate how the plan would fit into the NPS native fish management plan and the LTEMP EIS. Reclamation has agreed to consider the plan which would be developed by the TWG and then recommended by the

AMWG in fulfillment of this commitment in the biological opinion. Clearly Reclamation has the lead responsibility and requirement to fulfill this task, but the TWG would like the opportunity to take the lead on developing the draft plan for consideration by Reclamation. The TWG has established an ad hoc group which will facilitate the development of a robust plan that incorporates all AMP stakeholders, as well as other interested parties such as the Marble Canyon business community and others. It is unclear how this plan would be integrated with the NPS native fish management plan, but some stakeholders felt that it could provide the detailed methods which could be used to attain the goals provided in such broader plans (e.g., LTEMP EIS, NPS native fish management plan).

See Attachment 1, "Initial Draft for Discussion, A Research and Monitoring Plan for Evaluating Trout Management Flows below Glen Canyon Dam."

Update on Humpback Chub Five-Year Status Report

In Fall 2011, the U.S. Fish and Wildlife Service (USFWS) completed a five-year status review for humpback chub. The review considers progress made towards the 2002 recovery goals. Pam Sponholtz of the USFWS briefed the TWG on progress made towards the recovery goals and the determinations in the review. Pam Sponholtz also addressed questions about the review submitted Western and the USFWS written responses.

Generally, the recovery goals represent an agreement with the American people to encourage work toward recovery of a species through the implementation of recovery actions (e.g., translocations, habitat maintenance, flows, nonnative fish management, etc.), with the potential of a reward of downlisting (from endangered to threatened) or delisting (removing from the list) when those objective and measureable criteria are reached. The status review is significant in that it provides a report card on how well the recovery effort is progressing. The report provides an assessment of whether the demographic and threats criteria have been achieved or whether there is more work to do. The status review and progress towards recovery also has an impact on section 7 biological opinions, as can be seen in the 2011 biological opinion recently provided by the USFWS.

The USFWS, led by Region 6, is in the process of revising the recovery goals, so those considered in this status review may be modified. A revised draft of the recovery goals will be subject to peer and public review processes as required by the ESA.

In the humpback chub status review, the USFWS indicated progress had been made with regard to many of the criteria, while others, specifically the demographic criteria (population size and growth), have not been met. Numerous threats criteria have been met, while some are still left to complete (e.g., spill management plan for the bridge over the Little Colorado River at Cameron).

Concerns still exist on the part of some stakeholders regarding the application of the criteria to the lower basin recovery unit, and we propose continued discussion between those stakeholders and the USFWS during the development of the revised recovery goals.

See Attachment 2, "Humpback chub *(Gila cypha)* 5-Year Review: Summary and Evaluation."

Update from TWG Cultural Resources Ad Hoc Group

In a motion passed at its August 2011 meeting, the AMWG directed the TWG to reconstitute the Cultural Resources Ad Hoc Group and make a recommendation to the AMWG on the following at its February 2012 meeting.

> Issue #3: AMWG indicates its intention of make a recommendation to the Secretary on the following questions: How should the program fairly treat conflicts of cultural values, specifically those involving Native American perspectives? How will tribal values be monitored and tracked in this program?

At its meeting in January 2012, the CRAHG recognized that any recommendations the ad hoc group generates could be significantly affected by the new Department of the Interior Policy on Consultation with Indian Tribes, and the subsequent Secretarial Order 3317, both issued in December 2011.

The following represents a progress report to the TWG concerning the CRAHG's work, in the form of a sample of the draft recommendations currently being discussed. The CRAHG will present its recommendation to the TWG in April, for consideration and possible action by AMWG in May. The TWG discussed these issues and will work to begin implementing the types of recommendations within its purview. For example, we are working on an alternative location for the April TWG meeting that could begin address issues related to "how will tribal values be monitored and tracked in this program?" below.

<u>How should the program fairly treat conflicts of cultural values, specifically those involving Native American perspectives?</u>

1. AMWG/TWG should spend more time and effort at trying to achieve consensus among the stakeholders regarding issues.
    - Agreement by AMWG to work harder (i.e., good faith effort) to achieve consensus.
    - Federal agencies (e.g., BOR) should be more transparent about why they are making certain decisions.
    - Federal agencies should take the initiative to sponsor meetings regarding topical issues to reflect their sincerity in working on issues, rather than waiting for tribes to take the initiative.

2. Respect each stakeholder's perspective and position.
    - Acknowledge and foster increased respect among stakeholders (at all levels).
    - Acknowledge and accept that some stakeholders will not have respect or be willing to objectively listen.

3. Listen – actually "hear" and understand what is being said (effective communication).
    - Continue talking, talking, talking: It makes a huge difference in understanding and through effective communication new options can emerge.

4. Acknowledge, accept, and respect philosophical differences that are represented by the various stakeholders regarding the ecosystem.

- Presentations by individual stakeholder groups at AMWG meetings ("Stakeholders' Perspectives") are very productive. Stakeholder presentations should by recorded for use as educational tools for new stakeholder representatives to the AMWG/TWG and new scientists employed by GCMRC.
- Educate about the values beyond those from a western scientific perspective.
- Educate about tribal issues and concerns. Educate AMWG/TWG stakeholders about "tribal values," what these values mean, and that a monetary value or qualitative value cannot be placed on these values.

How will tribal values be monitored and tracked in this program?

1. Traditional ecological knowledge (TEK) integration process initiated and integrated into the Grand Canyon Monitoring and Research Center's science program.
2. Cultural sensitivity workshops and/or training sessions
    - Two-pronged approach – joint TWG/AMWG river trip with Tribes setting the agenda and AMWG/TWG meetings at Tribal homelands.
3. Define basis (metrics) for determining success.
4. Stakeholder meetings in Page with a one-day visit to the Glen Canyon Dam.
5. Stakeholder meetings at Grand Canyon National Park.
6. Stakeholder one-day river trip to Glen Canyon Reach and the Dam.
7. River trips with Tribal representatives are very important, coupled with stakeholder participation in tribal sensitivity workshops held in the respective tribal community. Feedback evaluations by stakeholders who participate in tribal sensitivity workshops. Sensitivity training for GCMRC employees and contract scientists is equally important.
8. Incorporate reflexivity into GCMRC's science program.
9. Annual report that tracks efforts at sensitivity sharing of cultural values among stakeholders, tracks conflicts of cultural values that emerge within the program, and efforts at tribal consultation to resolve conflicts.

REFERENCES

Valdez, R.A., Capron, S., Korman, J.S., LaGory, K. and C. Walters. 2010. Nonnative Fish Control for the Colorado River through Grand Canyon - A Discussion Paper August 4, 2010. References Saguaro Lake workshop white paper.

Attachment 1

Initial Draft for Discussion

A Research and Monitoring Plan for Evaluating Trout Management Flows below Glen Canyon Dam

Introduction

This science plan was developed to support the Environmental Assessment for Non-Native Fish Control Downstream from Glen Canyon Dam dated December 30, 2011 (hereafter referred to as the Non-Native Fish Control EA). The purpose of the proposed action for the Non-Native Fish Control EA is to minimize the negative impacts of competition and predation by nonnative fish on the endangered humpback chub in Grand Canyon. Reclamation identified several mechanical removal and flow-related research questions to better manage non-native fish populations below Glen Canyon Dam in their EA. Data needs relating to mechanical removal of non-native fish were addressed in a science plan presented as an Appendix B to the Non-Native Fish Control EA. The science plan presented in this document addresses data needs relating to the flow-related management options identified in the EA. These data needs were identified as being:

- Determine if stranding flows could reduce rainbow trout recruitment in the Lees Ferry reach by dewatering redds or stranding juvenile trout;
- Evaluate the potential for utilizing changes in down-ramp rates to strand or displace juvenile trout and reduce recruitment;
- Evaluate different types and magnitudes of stranding flows;
- Determine if flow and non-flow actions at Lees Ferry would be effective in improving the Lees Ferry trout fishery.

A workshop coordinated by the Grand Canyon Monitoring and Research Center (GCMRC) at Saguaro Lake, AZ, on April 13-14, 2010, was held to discuss how to balance nonnative fish populations, specifically the rainbow trout fishery at Lees Ferry, with conservation of native and endangered fish species in Grand Canyon. Stakeholders, including representatives from Arizona Department of Fish and Game (AZDFG), U.S. Fish and Wildlife Service (USFWS), U.S. Bureau of Reclamation (Reclamation), and private interest groups were involved with formulating ideas of how to best manage the Lees Ferry trout population without unduly impacting other resources associated with the Grand Canyon. These ideas were coalesced

into a discussion paper in May 2010 which was then provided to Reclamation to assist in the development of the Non-Native Fish Control EA. Trout management flows were identified as a potential treatment that would likely complement mechanical removal in reaching program objectives. Studies relating to mechanical removal are scheduled to begin in the fall of 2011with the start of the Natal Origins project and removal of rainbow trout in the Paria to Badger Creek Rapid (PBR) reach is scheduled to begin in 2012.

In 2011, the large rainbow trout cohort produced after the 2008 HFE spawned during high, steady equalization flows designed to transfer water from Lake Powell to Lake Mead. This has apparently led to another year of high rainbow trout recruitment below Glen Canyon Dam. Preliminary data from the 2011 Natal Origins field work have produced estimates of over 1 million age-0 trout in the Lees Ferry Reach (J. Korman, Ecometric, pers. comm. 2011). This is 17 times higher than the estimate made after the 2008 HFE is likely contributing to the 800 percent increase in rainbow trout densities in the Little Colorado River (LCR) reach since 2006. This has once again shown how influential the discharge patterns from Glen Canyon Dam are on the population dynamics of rainbow trout in the Lees Ferry reach. This also suggests that flow management, along with mechanical removal, will be necessary to effectively manage the trout population to achieve a desired density and size-structure for the fishery and to protect downstream resources such as humpback chub from increased competition and predation.

Objectives

The purpose of implementing trout management flows is to evaluate methods for using releases from Glen Canyon Dam to reduce the production of large numbers of age-0 rainbow trout in order to improve the quality of the Lees Ferry trout fishery and conserve the endangered humpback chub and other native fishes in Grand Canyon. This science plan describes how to determine whether releases from Glen Canyon Dam can be used to manipulate the age and size structure of the rainbow trout fishery at Lees Ferry.

One of the management goals described in the Nonnative Fish Management Plan for Grand Canyon (Hilwig et al. 2009) is to reduce the trout population in the LCR reach to 10-20% of the January 2003 trout abundance (approximately 600-1,200 individuals). This management

objective has not been evaluated for its feasibility or efficacy, thus we do not know if this level of removal is sustainable or how it will influence current or future humpback chub recruitment. It is believed, however, that some level of trout reduction in the LCR reach is necessary to improve recruitment and foster the recovery of the humpback chub population in the Grand Canyon.

We identified three objectives that need to be addressed to support management decision making:

- Sustain a healthy Lees Ferry trout population with a balanced age and size structure;
- Reduce annual production rates of rainbow trout in the Lees Ferry reach;
- Reduce emigration rates of rainbow trout from Lees Ferry to downstream reaches occupied by humpback chub.

Key Assumptions

To determine the effect of a trout management flows on either the rainbow trout population at Lees Ferry or the humpback chub population in the Grand Canyon, these experiments needs to be applied for a duration that approaches or exceeds the generation time for the two fish populations of interest (three to five years for rainbow trout and four to six years for humpback chub). Alternatively, inferences regarding the impact of trout management flows could be made using data on how the treatments affect the growth and/or survival of younger lifestages as long as any density dependant responses are taken into account. Regardless of which approach is taken to reduce uncertainty (that is, designing management actions that are long enough in duration to elicit a population response, or designing shorter duration management experiments and monitoring vital rates of juvenile life stages), variation in environmental factors (for example, the increases in water temperatures during 2003-2006 trout removal project) can complicate interpretation of results.

We identified eight key assumptions involving the use of trout management flows to improve conditions for both the recreational fishery at Lees Ferry and for humpback chub in the Grand Canyon. Although recent research and monitoring has identified some uncertainty associated with these assumptions, there has been enough concern expressed by management agencies to take reasonable actions to avoid jeopardy to the humpback chub population and

promote the development of potential trout management flows. The following assumptions are listed in order of precedence meaning if an assumption listed near the top of the list turns out to be incorrect, the relevance of resolving subsequent assumptions may be reduced.

- Survival and recruitment of juvenile humpback chub rearing in the Colorado River mainstem are significant factors limiting the adult humpback chub population in the Grand Canyon;
- Competition and/or predation between humpback chub and rainbow trout in the Colorado River mainstem is significantly limiting survival and recruitment of juvenile humpback chub;
- Management actions being implemented to improve conditions for resources associated with the Grand Canyon river corridor are also increasing the production of age-0 rainbow trout in the Lees Ferry reach;
- The origin of rainbow trout near the confluence of the LCR is from the Lees Ferry reach;
- Maintaining moderate age-0 trout densities while preserving the aquatic foodbase in the Lees Ferry reach would result in fewer but substantially larger adult trout of better condition that are less likely to migrate downstream to the LCR reach;
- Decreasing the production of age-0 trout in the Lees Ferry reach would help reduce the need for long-term and continuous mechanical removal of rainbow trout in the LCR reach;
- Utilizing trout management flows to reduce the number of age-0 rainbow trout in the Lees Ferry reach would be more efficient, cost-effective, and culturally acceptable than relying solely on mechanical removal;
- Age-0 trout are more sensitive to flow variation during the period of their lifecycle when they are more likely to be found in low-angle shoreline habitat.

If all of these assumptions are relatively correct, then trout management flows will likely benefit both the rainbow trout fishery at Lees Ferry and the humpback chub population in the Grand Canyon. However, if the foremost assumption is found to be incorrect, it would negate the relevance of the remaining assumptions and the utility of the proposed management action. For example, if the Colorado River mainstem rearing environment is not contributing significantly to juvenile humpback chub growth, survival, and recruitment, then the observed changes in adult humpback chub abundance that have occurred since the early 1990's must be attributable to factors occurring in the LCR and are independent of what is occurring in the mainstem. If this is the case, it is unlikely that any management activity directed at the trout population in the mainstem would have significant positive benefits to humpback chub and the proposed action

would then need to be identified as a management tool solely to improve the trout fishery at Lees Ferry. On the other hand, if a relatively high proportion of humpback chub that move/disperse into the mainstem ultimately recruit into the adult population, then competition and predation by rainbow trout may in fact be limiting humpback chub recruitment and actions taken to change the dynamics of the trout population at Lees Ferry could improve conditions for the humpback chub population in Grand Canyon.

Critical Uncertainties and Hypotheses

In addition to assumptions identified above, five areas of critical uncertainty were identified that would have on the success or failure of any attempt to use flows to improve management the trout population at Lees Ferry.

- How would trout management flows impact the Lees Ferry fishery?
    - H_1: Trout management flows would decrease the number of age-0 trout competing with older cohorts for limited food resources thereby improving food availability for and condition of the larger trout which would in turn produce a higher quality trophy trout fishery.

- How would a reduction in age-0 trout impact the humpback chub population in the Grand Canyon?
    - H_2: Trout management flows would decrease emigration of age-0 trout from Lees Ferry to the LCR thereby decreasing competition and predation interactions between rainbow trout and humpback chub and improving the chances for humpback chub recovery.

- When do rainbow trout emigrate from the Lees Ferry reach to the LCR reach and when would trout management flows be most effective?
    - H_3: The majority of rainbow trout emigrating downstream of Lees Ferry do so at the end of their first year of life and they move primarily in spring. Trout management flows would be most effective during their first spring and summer when they are most likely to be found in shallow, near-shore habitats.

- What would be the most effective flow treatment to reduce age-0 trout densities without significantly impacting other resources?
    - H_4: Daytime dewatering of redds combined with mechanical removal of redds below the low water mark that would reduce the number of viable eggs.

- H_5: Age-0 trout habitat limiting flows that would reduce the habitat availability for age-0 trout making them more reliant on sub-optimal habitats where they would be subject to poor growing conditions.
- H_6: Age-0 trout stranding/displacement flows that would draw age-0 trout onto high elevation gravel bars and benches and then strand them by rapidly decreasing releases from Glen Canyon Dam.
- H_7: A combination of the aforementioned flow treatments, combined with mechanical removal of age-0 trout at the end of the summer, would result in a greater reduction in age-0 trout numbers than implementing any one treatment alone.

- What level of trout egg and alevin mortality would be necessary to overcome any density dependent compensatory response?
  - H_8: Redd-induced mortality of somewhere between 50% and 90% would be sufficient to overcome any density dependent compensatory response. This level of treatment, however, may significantly impact other resources such as aquatic foodbase.

- What is the target number of rainbow trout in the LCR reach that would keep competition with and predation of humpback chub sufficiently low to insure adequate recruitment?
  - H_9: Achieving the management goal of 10-20% of the January 2003 trout abundance (600-1,200 individuals) is necessary to maintain adequate recruitment of humpback chub.

Development of Treatments

The blue ribbon rainbow trout fishery at Lees Ferry is a valued and popular recreational fishery that has been the focus of a series of extensive monitoring projects by state and federal agencies since shortly after the closure of Glen Canyon Dam. High, steady releases from Glen Canyon Dam during the spring and summer of 2011 appear to have contributed to a recruitment event that is 10 to 20 times higher than any recruitment event since monitoring in the Lees Ferry reach began, including the high production year following the 2008 high flow experiment. Although this recruitment event may sound like a positive thing for the Lees Ferry fishery, monitoring by the AZDGF and the GCMRC from 1991-2009 has shown that the fishery is becoming increasingly dominated by smaller, subcatchable trout and the catch of larger, trophy-sized trout is becoming relatively rare. This monitoring has also shown that as the number of smaller trout increases, the condition index of larger trout decreases (Makinster et al. 2011). This

is believed to be because the dynamics of the trout population are primarily driven by food availability and competition between larger, older fish and these younger age classes. In a year of exceptional trout production, such as 2008 and 2011, these younger age classes can overwhelm the foodbase in the Lees Ferry reach resulting in less than optimal conditions for the larger, more desirable trout.

These high recruitment events also raise the concerns of managers tasked with the conservation of the endangered humpback chub and the other native fish populations below Glen Canyon Dam. Rainbow trout have been identified as a competitor and a predator of humpback chub and other native fishes in the Colorado River below the dam. There are a number of ongoing studies intended to monitor the trout population at Lees Ferry and to track potential conflicts with native fish populations in Grand Canyon. Several management actions in the Non-Native Fish Control EA are currently being considered that may have a substantial impact on how the fishery is managed in the future. One such action, implementation of flow experiments to reduce the number of trout produced by high flow experiments, was recommended in the most recent biological opinion for operations at Glen Canyon Dam.

The objective of this paper is to describe a series of possible management actions that could reduce rainbow trout recruitment such that emigration out of the Lees Ferry Reach is minimized while enhancing the quality of rainbow trout within the Lees Ferry Reach. These treatments were developed by several stakeholders including AZDFG, GCMRC, USFWS, and Reclamation with the following objectives in mind:

1. Rebuild and maintain the blue-ribbon trophy trout fishery between Glen Canyon Dam and Lees Ferry;
2. Reduce emigration rates of rainbow trout from Lees Ferry to downstream reaches occupied by humpback chub and other native fishes.

This proposal is to experiment with releases at Glen Canyon Dam to determine if certain flow combinations are effective at manipulating the trout population at Lees Ferry to a more desirable state without unduly impacting other valued resources in the project area. The dual goals of improving the sport fishery while reducing conflicts between sport fish and native fish

management are considered equally important to the success of any trout management flow treatment. Also critical to the success of a flow treatment will be the assessment of other valued resources in the canyon including such things as conservation of the aquatic foodbase, sediment, cultural value and perspectives, and impacts to recreation and power production.

Treatment 1: Redd stranding flows with mechanical removal of redds below the minimum flow elevation.

This treatment uses flow manipulation at Glen Canyon Dam to periodically dewater redds (nests trout build to lay their eggs in) during the rainbow trout spawning period thereby reducing the number of viable eggs that could hatch and recruit to the age-0 trout population. The objective of this treatment would be to dewater and/or mechanically remove between 50% and 90% of the redds produced over the spawning season. These types of flows are thought to have limited age-0 trout recruitment under pre-ROD conditions.

Redd stranding flows could be implemented within current ROD guidelines and would consist of a period of high steady flows (between 17 and 21 kcfs) for an extended period of time (i.e. 18 hours to several days) to encourage fish to spawn on higher elevation gravel bars and benches during the peak spawning period (February-April). Flows would then be reduced to between 15 and 9 kcfs (or the monthly minimum flow of 5 or 8 kcfs) for a dewatering treatment lasting 10-12 hours and occurring every 2-4 weeks over the incubation period (mid-March to mid-May). This treatment should occur during the daytime to take advantage of heating the spawning gravels which is more effective at reducing the survival of eggs and alevins (newly hatched trout) than just dewatering them. Redds below the minimum flow elevation could be mechanically treated using a hydraulic pressure washer in shallow water or a suction dredge in deeper water to increase the effectiveness of this treatment.

This treatment would likely be most effective during periods of extended high flows (i.e. equalization flows) due to the tendency of trout to spawn higher on gravel bars under these flow conditions. The effectiveness of this treatment is limited by how low flows could be reduced without impacting other valuable resources in the canyon, such as aquatic foodbase resources used by adult rainbow trout. Mechanical removal of redds would be less labor intensive than

mechanical removal of age-0 fish. However, strong compensatory mechanisms of increased fry survival under low density conditions could result in little observable effect in age-0 trout unless redd removal was substantially greater than natural levels of egg and fry mortality combined.

Redd stranding flows would have negligible affects to adult and juvenile humpback chub in the mainstem since they occupy and utilize habitats that that are only minimally affected by flow fluctuations at this time of year. This treatment would conclude prior to age-0 humpback chub use of nearshore mainstem habitats. Flannelmouth suckers spawning in the Paria Rapid reach may be affected by these flows at this time of year. Impacts to power production could be mitigated by using a weekend treatment but this might negatively impact fishing and boating recreation by making the river more difficult to navigate. A daytime treatment, as prescribed here, would also be highly visible to anglers and other groups, thus extensive outreach would be needed to maintain public support for this treatment. Angler success might improve during the treatments due to lower water levels, concentration of fish, and the disturbance of the benthos (organisms living in the river bottom) during mechanical treatment of redds. Disturbance of the benthos from mechanical treatment would be a localized short-term effect. Redd stranding flows could be combined with any of the following treatments to increase the cumulative effect of conducting multiple treatments and in offsetting the impact of compensatory mechanisms at various life stages.

Treatment 2: Age-0 Trout Habitat Limiting Flows.

This treatment relies on daily flow fluctuations to reduce the habitat availability of age-0 trout (fry and juveniles) making them more reliant on sub-optimal habitats where they would be subject to poor growing conditions. Daily flow fluctuations have been shown to negatively impact age-0 trout without affecting larger trout (Makinster et al. 2011). Under this flow regime age-0 trout are more likely to remain in deeper, colder water exposing them to decreased growth. This treatment has already been implemented to some extent with MLFF and is considered to be a control mechanism that does reduce the fitness of age-0 trout under current operations.

Habitat limiting flows could be provided within ROD guidelines with MLFF or the treatment could be enhanced by increasing the allowable daily fluctuation when age-0 trout are

most sensitive to flow fluctuations (May-August). A nighttime minimum flow treatment would be more effective than a daytime treatment because age-0 trout typically come closer into shore at night. Currently, the ROD limits daily fluctuations from May to August to between 6 and 8 kcfs depending on monthly release volumes. Increasing limits on daily fluctuations beyond ROD limits on at least a weekly basis would likely increase the effectiveness of this treatment but may increase impacts to other resources in the canyon as well. A critical component of this treatment would be to ensure that flows drop to between 15 and 9 kcfs (or to the monthly minimum flow of 8 kcfs) for 12-14 hours on at least a weekly basis to dewater shallow gravel bars and benches in the Lees Ferry reach.

This treatment would likely be most effective during periods of time when releases from Glen Canyon Dam are already fluctuating for power generation. This treatment could also be incorporated into other flows scenarios such as equalization as long as a periodic flow reduction below 15 kcfs could be achieved at least once per week. This treatment is already being provided to some extent under normal operations at Glen Canyon Dam with MLFF and it may be more effective at having a population level response than redd stranding flows because it is targeting an older age class that is less likely exhibit a density-dependent response.

Habitat limiting flows would have negligible affects to adult and juvenile humpback chub in the mainstem since at this time of year they occupy and utilize habitats that that are only minimally affected by flow fluctuations. This treatment may affect juvenile and age-0 humpback chub use of nearshore habitats in the mainstem but impacts would be similar to existing fluctuating conditions and indications are that survival of juvenile and age-0 humpback chub in the mainstem can be relatively high under these conditions (i.e., MLFF; See Reclamation's supplement to biological assessments for Development and Implementation of a Protocol for High-Flow Experimental Releases and Non-native Fish Control Downstream from Glen Canyon Dam. Arizona, 2011 through 2020 for a full discussion of recent science pertaining to the Near Shore Ecology project, 2008-2010, Dr. B. Pine, Univ. of Florida.). Other impacts to resources would be similar to those already identified in the 1995 EIS and ROD.

Treatment 3: Age-0 Trout Stranding/Displacement Flows.

This treatment relies on a period of high steady flows to draw age-0 trout (fry and juveniles) onto high elevation gravel bars and benches and then stranding those fish by rapidly decreasing releases from Glen Canyon Dam. The age-0 trout that do not get stranded would be displaced into less favorable habitats resulting in impacts similar to those discussed above for Treatment 2.

Age-0 trout stranding/displacement flows could be provided within ROD guidelines with the treatment consisting of a period of high steady flows (between 17 and 21 kcfs) for an extended period of time (i.e. 18 hours to several days or weeks) to encourage age-0 trout to inhabit high elevation gravel bars and benches. Flows would then be rapidly reduced to between 15 and 9 kcfs (or the monthly minimum flow of 8 kcfs) for a dewatering treatment lasting 10-12 hours and occurring every 2-4 weeks. This treatment would take place from May to August when age-0 trout are most likely to be in these near-shore habitats. A nighttime minimum flow treatment would be more effective than a daytime treatment because age-0 trout typically come closer into shore at night. Increasing downramp rates beyond ROD guidelines may make this treatment more effective. The ROD currently limits downramp rates to 1,500 cfs/hr to reduce the probability of stranding young fish in nearshore habitats. Operationally, down ramping from 33,200 cfs (maximum power plant capacity at Glen Canyon Dam) to the daily minimum of 8 kcfs could occur nearly instantaneously.

This treatment would be most effective during periods of extended high flows (i.e. equalization flows) due to the likelihood of age-0 fish of utilizing high elevation gravel bars and benches when flows are held high and steady for an expanded period of time. As with Treatment 2, this treatment may be more effective at having a population level response than redd stranding flows because it is targeting an older age class that is less likely to exhibit a density-dependent response. This treatment, however, may also strand larger, more desirable trout occupying nearshore habitat during the night as well. Any larger fish caught in the nearshore during a stranding event would likely be more susceptible to mortality than smaller, age-0 fish because they would not be able to escape or endure the stranding as readily as a smaller fish.

Age-0 stranding/displacement flows would have negligible affects to adult humpback chub since they occupy and utilize habitats that that are only minimally affected by flow

fluctuations. Rapid downramp rates may affect juvenile and age-0 humpback chub use of the nearshore in the mainstem with greater affects impacting humpback chub aggregations located nearer to Glen Canyon Dam. This treatment may negatively impact bluehead sucker spawning in June and July. The aquatic foodbase in the Lees Ferry reach may reset at a higher elevation with high steady flows and then be greatly reduced with the occasional drawdown. High steady flows generally have negative impacts on power production and sediment transport and off-schedule low flows may affect rafting safety in rapids and result in stranding large rafts on camping beaches.

Treatment 4: Mechanical Removal of Age-0 Trout.

This treatment calls for the mechanical removal age-0 trout in the Lees Ferry reach with boat-mounted electrofishing equipment. Mechanical removal of age-0 trout could be used to complement the aforementioned flow-based treatments when those treatments are not fully successful in reducing the age-0 trout population to an end-of-summer target or it could be used exclusively when conditions are such that using a flow-based treatment would not be effective. Mechanical removal studies are currently being considered to determine if a reduction in the trout population leads to a reduction in emigration into the LCR reach (e.g., Paria to Badger Rapid removals). This project could also be expanded into the Lees Ferry reach to see if a reduction in age-0 trout leads to improved condition of larger trout. Mechanical removal has been shown to be effective at reducing trout densities in the LCR reach.

Many of the methodologies for mechanical removal of trout in Grand Canyon have been developed by GCMRC and its partners. Mechanical removal would be done at night from September to October and in the Lees Ferry reach would only focus on the removal of age-0 trout. Removal would be done using a slow speed-multiple pass method from an electrofishing boat focusing on nearshore talus habitats. It is estimated that under relatively low age-0 trout abundance conditions, approximately 40 nights of effort could reduce the age-0 trout population by about 80% of its pre-removal abundance. For comparison, approximately 75 days per year were dedicated to nonnative fish removal during the LCR trout removal efforts from 2003 to 2006.

This treatment would be most effective during periods of time when nighttime releases from Glen Canyon Dam are relatively low (i.e. during MLFF flows). High steady flows not only lead to the production of large numbers of age-0 trout that can overwhelm such removal efforts but also increase fish dispersal into deeper, faster water making them more difficult to catch and remove.

Mechanical removal of age-0 trout in the Lees Ferry reach would have negligible affects to humpback chub and other native fish since native fish are largely absent from this reach of the river. An advantage of mechanical removal is that it eliminates many of the potential negative effects of trout management flows, such as reductions in the aquatic foodbase and impacts to the boating or fishing communities. Mechanical removal is also a very controllable action that can be stopped when the age-0 trout population has been reduced to a targeted level.

Treatment Implementation schedule

Differences in the efficiency of trout management flows and mechanical removal suggest that each of the four treatments discussed above may be more effective under some flow scenarios than others. For example, redd stranding flow and age-0 trout stranding flows would likely be more effective when releases can be held high and steady for an extended period of time (i.e. equalization flows) whereas age-0 trout habitat limiting flows and mechanical removal would likely be more effective at lower flows more typical of power operations. Releases from Glen Canyon Dam could also be manipulated for short periods of time to where the four treatments outlined above could be used sequentially to target different vulnerabilities of age-0 trout as they age over the course of the year. Several scenarios are presented below for how trout management flows could be incorporated into various release schedules for a range of upcoming water years.

Scenario 1. High and steady releases for the year.

This scenario describes a combination of possible trout management flows that could be implemented when releases from Lake Powell must be maintained at or near power plant capacity for an extended period of time (e.g. to meet equalization levels with Lake Mead). Beginning in February, set daytime maximums to between 17 and 21 kcfs (or higher if necessary) and hold for at least 18 hours at a time to encourage fish to spawn at higher elevations on gravel bars. Conduct a pre-treatment redd count to get an estimate of trout production. Once every 2-4 weeks beginning in mid-March, reduce releases early in the morning to between 15 and 9 kcfs (or the daytime minimum flow 8 kcfs or lower if allowable) and hold for 10-12 hours. During the day of the treatment when the water levels are low, remove redds located below the minimum flow elevation with a hydraulic pressure washer or a suction dredge. Repeat every 2-4 weeks until May. Beginning in May, downramp flows one day every 2-4 weeks as fast as allowable to between 15 and 9 kcfs (or the seasonal minimum flow of 8 kcfs) for a nighttime stranding treatment lasting 10-12 hours. Repeat every 2-4 weeks until August. During the first week of August, perform a population estimate on the age-0 trout population. If the population estimate exceeds production goals, proceed with mechanical removal. During each nighttime mechanical removal effort, reduce flows as low as permissible to concentrate age-0 trout. Continue mechanical removal until the age-0 trout population estimate reaches the annual production goal.

Scenario 2. High and steady releases in the early spring followed by fluctuating flows summer and fall.

This scenario describes a combination of possible trout management flows that could be implemented when releases from Lake Powell must be maintained at or near power plant capacity (e.g. to meet equalization levels with Lake Mead) from winter into the early spring but then switch to a fluctuating flow regime (e.g. MLFF) in the summer and fall. Beginning in February, set daytime maximums to between 17 and 21 kcfs (or higher if necessary) and hold for 18 hours at a time to encourage fish to spawn at higher elevations on gravel bars. Conduct a pre-treatment redd count to get an estimate of trout production. Once every 2-4 weeks beginning in mid-March, reduce releases early in the morning to between 15 and 9 kcfs (or the daytime

minimum flow 8 kcfs or lower if allowable) and hold for 10-12 hours. During the day of the treatment when the water levels are low, remove redds located below the minimum flow elevation with a hydraulic pressure washer or a suction dredge. Repeat every 2-4 weeks until May. Beginning in May proceed with age-0 trout habitat limiting flows (MLFF) making sure that flows at the very least drop below 15 kcfs for 12-14 hours on a weekly basis. Continue these flows until August. During the first week of August, perform a population estimate on the age-0 trout population. If the population estimate exceeds production goals, proceed with mechanical removal. Continue mechanical removal until the age-0 trout population estimates reach the annual production goal.

Scenario 3. MLFF for the year.

This scenario describes a combination of possible trout management flows that could be implemented when releases from Lake Powell are being operated under a fluctuating flow regime (e.g. MLFF) for the year. Beginning in February, set daytime maximums to between 17 and 21 kcfs (or higher if necessary) and hold for 18 hours at a time to encourage fish to spawn at higher elevations on gravel bars. During this time, reduce nighttime flows by 6 or 8 kcfs (depending on monthly release volumes) according to ROD guidelines. Conduct a pre-treatment redd count to get an estimate of trout production. Once every 2-4 weeks beginning in mid-March, reduce releases early in the morning to between 15 and 9 kcfs (or the daytime minimum flow 8 kcfs or lower if allowable) and hold for 10-12 hours. Remove redds located below the minimum flow elevation with a hydraulic pressure washer or a suction dredge when the water levels are low. Repeat every 2-4 weeks until May. Beginning in May proceed with age-0 trout habitat limiting flow treatments increasing daily maximum and minimum releases and ramping rates to as high of a level as allowable. Make sure that flows drop below 15 kcfs for 12-14 hours on at least a weekly basis. Continue with these flows until August. During the first week of August, perform a population estimate on the age-0 trout population. If the population estimate exceeds production goals, proceed with mechanical removal. Continue mechanical removal until the age-0 trout population estimates reach the annual production goal.

Linkages to Existing Monitoring and Research Projects

As part of the Glen Canyon Adaptive Management Program, there are five existing long-term monitoring projects that will also provide additional data to evaluate the efficacy of using trout management flows to meet the aforementioned objectives. These long-term monitoring projects include:

- Monitoring Lees Ferry Fishes (BIO 4.M2.10) – Ongoing status of the Lees Ferry trout fishery (adult and juvenile fish);
- Monitoring Mainstem Fishes (BIO 2.M4.10) – Ongoing downstream monitoring of nonnative fish distribution and relative abundance in the mainstem (includes Diamond down);
- Stock Assessment of Native Fish in Grand Canyon (BIO 2.R7.10) – Age-structured mark recapture (ASMR) recruitment modeling update for adult humpback chub (Age- 4+);
- Little Colorado River Humpback Chub Monitoring (BIO 2.R1.10) – Annual point estimates for HBC population in the lower 13.57 km;
- Mainstem HBC Aggregation Trips – Distribution and relative abundance of humpback chub in the mainstem.

Research and reporting efforts that are part of the monitoring and research programs associated with the mainstem and its tributaries will also help inform the adaptive decision-making process.

- Annual Nonnative Fish Workshop – A scientists/manager workshop to review current data/finding and adapt the program as needed, GCMRC biannual work plan project (BIO 2.R17.11-12);
- Evaluate Lees Ferry Recreation Experience Quality – To assess how will multiple high flows and other flow experiments conducted over the next 10 years affect recreational experience quality in the Colorado River corridor in Glen Canyon (REC 9.R4.11,12);
- Brown trout removal at Bright Angel Creek conducted by the National Park Service;
- Continued ecosystem modeling (PLAN 12.P1.11,12).

Annual Reporting

Annual reporting is scheduled to occur in early December as part of the GCMRC's Annual Fish Cooperators Meeting. A written summary will also be provided that includes the annual resource assessment and criteria for supporting the decision making process to be used for the coming year. The primary information provided will include:

1) Lees Ferry redd count and estimate of number of redds dewatered and mechanically removed;
2) Lees Ferry age-0 trout marking numbers and recaptures in the Lees Ferry, PBR, and Marble Canyon/LCR reaches [data from the Monitoring Lees Ferry Fishes (BIO 4.M2.10) and Monitoring Mainstem Fishes (BIO 2.M4.10) projects];
3) Lees Ferry age-0 trout abundance estimates and total fish catch and removal.

General Budget

Under development

References Cited

Hilwig, K.D., Andersen, M.E., Coggins, L.E., Jr. 2009. Nonnative fish management plan for Grand Canyon—a comprehensive approach to management and research of nonnative fish species. U.S. Geological Survey Planning Document. 79 p.

Makinster, A.S., Persons, W.R., and Avery, L. A., 2011, Status and trends of the rainbow trout population in the Lees Ferry Reach of the Colorado River downstream from Glen Canyon Dam, Arizona, 1991-2009: U.S. Geological Survey Scientific Investigations Report 2011-5015, 17 p.

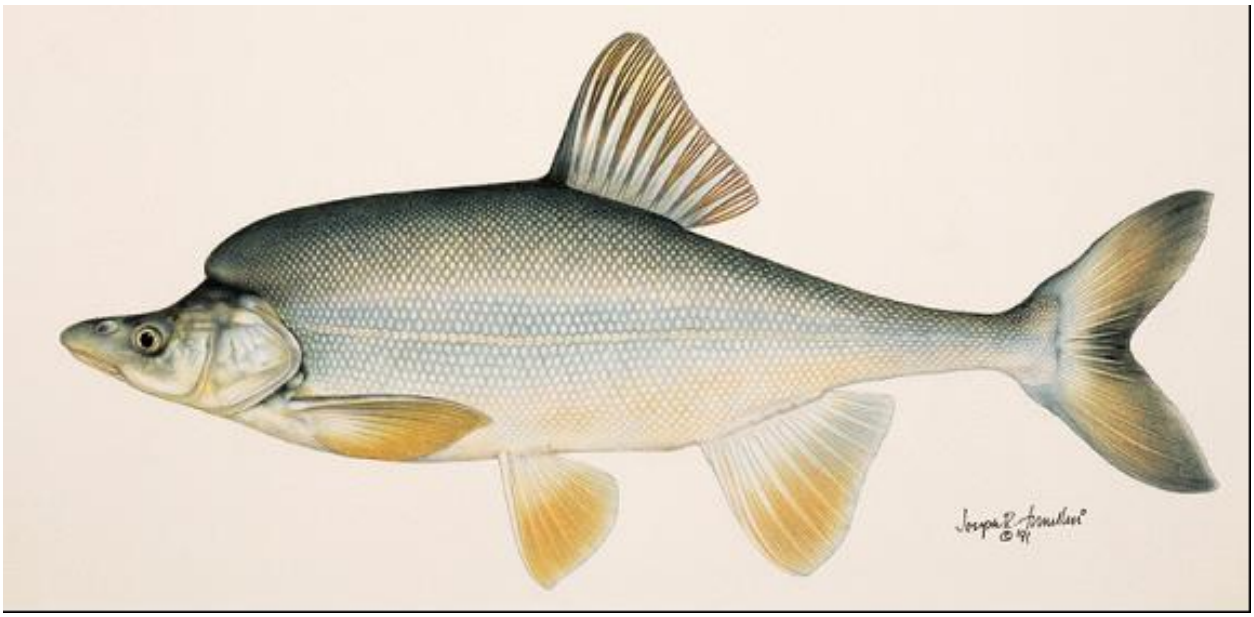
Table 1. Description of parameters for the three flow-related treatments and mechanical removal to manage the rainbow trout fishery at Lees Ferry.

	Treatment 1: Redd stranding flows with mechanical removal of redds	**Treatment 2: Age-0 Trout Habitat Limiting Flows**	**Treatment 3: Age-0 Trout Stranding/ Displacement Flows**	**Treatment 4: Mechanical Removal of Age-0 Trout**
Effective flow conditions	High steady flows (equalization)	Operations (MLFF)	High steady flows (equalization)	Operations (MLFF)
Time frame	February-April	May-August	May-August	September-October
Frequency	One day every 2-3 weeks (weekend)	Nightly to one night per week	One night every 2-3 weeks	Five, week-long, nightly treatments
Duration	Daytime	Nighttime	Nighttime	Nighttime
Maximum release	Daytime (non-treatment): 17k to 21k up to 25k	Daytime: 17k to 21k up to 25k	Daytime: 17k to 21k up to 25k	Daytime: up to 25k (ROD)
Minimum release	Daytime (treatment): Dewatering: 9k to 15k or as low as permissible Mechanical removal: 8k (ROD) or as low as permissible Nighttime (non-treatment): 5k to 25k	Nighttime: 9k to 15k or as low as permissible (ROD: 5k)	Nighttime: 9k to 15k or as low as permissible (ROD: 5k)	Nighttime (treatment): As low as permissible (ROD: 5k) Nighttime (non-treatment): 5k to 25k
Up ramp rate	4kcfs/hr (ROD)	4kcfs/hr (ROD)	4kcfs/hr (ROD)	4kcfs/hr (ROD)
Down ramp rate	1500 cfs/hr (ROD)	1500 cfs/hr (ROD)	As fast as permissible	1500 cfs/hr (ROD)

Attachment 2

Humpback chub
(Gila cypha)

5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Upper Colorado River Endangered Fish Recovery Program
Denver, Colorado

2011

TABLE OF CONTENTS

LIST OF FIGURES

FIGURES

LIST OF TABLES

TABLE

5-YEAR REVIEW
Humpback chub/*Gila cypha*

1.0 GENERAL INFORMATION

1.1 Purpose of 5-year Reviews

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.2 Reviewers

Lead Regional Office: Mountain-Prairie Region (6)
Mike Thabault, Assistant Regional Director-Ecological Services, 303/236-4210
Bridget Fahey, Chief of Endangered Species, 303/236-4258
Seth Willey, Regional Recovery Coordinator, 303/236-4257

Lead Field Office:
Upper Colorado River Endangered Fish Recovery Program
Thomas Chart, Program Director, 303/969-7322, ext. 226

Cooperating Field Offices:
Ecological Services Field Office, Grand Junction, Colorado
Al Pfister, Assistant Field Supervisor, 970/243-2778

Colorado River Fisheries Program, Grand Junction, Colorado
To Be Announced, Field Supervisor, 970/245-9319, ext.19

Ecological Services Field Office, Salt Lake City, Utah
Larry Crist, Field Supervisor, 801/975-3330, ext. 126

Ecological Services Field Office, Cheyenne, Wyoming
Mark Sattelberg, Field Supervisor, 307/772-2374, ext. 34

Arizona Fishery Resources Office, Whiteriver, Arizona
Stewart Jacks, Field Supervisor, 928/338-4288

Lower Colorado River Coordinator, Phoenix, Arizona
Sam Spiller, Coordinator, 602/242-0210, ext. 240

Ecological Services Field Office, Phoenix, Arizona
Steve Spangle, Field Supervisor, 602/242-0210, ext. 244

California-Nevada Ecological Services Field Office, Reno, Nevada
Ted Koch, Field Supervisor, 775/861-6331

Cooperating Regional Office(s):

Southwest Region (2)
Michelle Shaughnessy, Assistant Regional Director-Ecological Services, 505/248-6646
Susan Jacobsen, Chief of Endangered Species, 505/248-6641
Wendy Brown, Regional Recovery Coordinator, 505/248-6664

Pacific Southwest Region (8)
Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants, 916/414-6464

1.3 Methodology Used to Complete the Review

On April 18, 2007, we published a Notice of Review in the *Federal Register* (72 FR 19549) soliciting any new information on the humpback chub that may have a bearing on its classification as endangered or threatened. Less than 20 people/agencies provided comments. All substantive comments and issues raised were considered. This 5-year review was primarily written by the Upper Colorado River Endangered Fish Recovery Program Office with substantive contributions and review by cooperating field and regional offices. It summarizes and evaluates information provided in the recovery goals, current scientific research, and surveys related to the species. All pertinent literature and documents on file at the Upper Colorado River Endangered Fish Recovery Program Office were used for this review (see References section below for cited documents). Interviews with individuals familiar with humpback chub were conducted as needed to clarify or obtain specific information.

1.4 Background

1.4.1 FR Notice Citation Announcing Initiation of This Review:

72 FR 19549 April 18, 2007.

1.4.2 Listing History

Original Listing
FR notice: 38 FR 106
Date listed: June 4, 1973
Entity listed: Chub, humpback; *Gila cypha*
Classification: Endangered, rangewide

1.4.3 Associated Rulemakings

59 FR 13374; March 21, 1994 - Critical Habitat Designated

66 FR 58748; November 23, 2001 - Reopening of Public Comment on Draft Recovery Goals for Four Endangered Fishes of the Colorado River Basin

67 FR 55270 55271; August 28, 2002 - Notice of Availability of Recovery Goals for Four Endangered Fishes of the Colorado River Basin

1.4.4 Review History: Historic 5-year reviews for all species, including the humpback chub were initiated by the Service's Washington, D.C., office in 1979, 1985, and 1991 (44 FR 29566, May 21, 1979; 50 FR 29901, July 22, 1985; 56 FR 56882, November 6, 1991). The species' status also was considered in the 1990 recovery plan and 2002 recovery goals (Service 1990; 2002).

1.4.5 Species' Recovery Priority Number at Start of 5-year Review: The humpback chub has a high recovery priority number of 2C. Species with a high priority rank (1, 1C, 2, 2C) are those that are the most threatened and have the highest potential for recovery. The "C" identifies that there is the potential for conflicts between needed recovery actions and economic activities.

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C*
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

The above ranking system for determining Recovery Priority Numbers was established in 1983 (48 FR 43098, September 21, 1983, as corrected in 48 FR 51985, November 15, 1983).

1.4.6 Recovery Plan

Name of plan or outline: Humpback chub (*Gila cypha*) Recovery Goals: amendment and supplement to the Humpback Chub Recovery Plan.

Date approved: August 1, 2002

Dates of previous revisions, if applicable: September 19, 1990

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

This section of the 5-year review is not applicable to this species because the humpback chub was not listed as a distinct population segment nor is there relevant new information for this species regarding the application of the distinct population segment policy.

2.2 Recovery Criteria

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress toward fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

There are three programs in the Colorado River Basin working to recover or conserve humpback chub populations: The Upper Colorado River Endangered Species Recovery Program and two conservation programs, the Glen Canyon Dam Adaptive Management Program and the Lower Colorado River Multi-Species Conservation Program. Each program has its own website that contains information about its respective program, projects and reports that were used to analyze the status of humpback chub.

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X__ **Yes**
_____ **No**

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

___ Yes
_X_ No

We recommend revising the Service's 2002 Humpback Chub Recovery Goals to incorporate new information on population dynamics. More specifically, the as-written Recovery Goal requirement that these populations always display positive recruitment (i.e., recruitment that is greater than adult mortality) contradicts the best available information that indicates these populations have and likely will experience fluctuations.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

_X_ Yes
____ No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The current status of humpback chub is endangered. Only the downlisting criteria are considered in this 5-year status review to determine if status can be changed (downlisted) to threatened. The downlisting criteria consider both the demographics of humpback chub and criteria that address the threats to the species. Analysis of each criterion is provided in italics directly below the criterion. Recovery of the species is considered basin wide, where extant populations exist (including five populations in the the upper basin recovery unit and the Grand Canyon population in the lower basin recovery unit). The downlist recovery criteria are from the recovery goals (Service 2002), Section 5.3 Objective, Measurable Recovery Criteria (pp. 42–46):

DEMOGRAPHIC DOWNLISTING CRITERIA FOR HUMPBACK CHUB

Historic abundance of the humpback chub is unknown, but is surmised from various reports and collections that indicate the species currently occupies about 68% of its historic habitat of about 756 km of river. Six self-sustaining populations of humpback chub are known to exist. Each of these populations consists of a discrete reproducing group of fish, with independent

stock-recruitment dynamics, and is geographically separated from other populations. Five of the populations occur in the upper basin recovery unit: 1) Black Rocks, Colorado River, Colorado; 2) Westwater Canyon, Colorado River, Utah; 3) Yampa Canyon, Yampa River, Colorado; 4) Desolation/Gray Canyons, Green River, Utah; and 5) Cataract Canyon, Colorado River, Utah (Service 1990). The only population in the lower basin recovery unit occurs in the mainstem Colorado River in Marble and Grand Canyons and the Little Colorado River.

Upper Basin Recovery Unit Criterion 1a: Each of the five self-sustaining populations is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that the trend in adult (age-4+; ≥ 200 mm TL) point estimates does not decline significantly.

Status of Upper Basin Recovery Unit Criterion 1a. ***This criterion has not been met.*** *Population models measure a variety of parameters, including probability of capture; these parameters provide a level of certainty and reliability to the Service for these estimates in determining acceptance. As a result, we can accept these estimates but do not consider the populations to be self-sustaining. A significant decline appears from the first adult abundance estimate to the most recent estimate for the populations in Black Rocks, Westwater Canyon and Desolation/Gray Canyons (FIGURE 1); 400 wild young-of-year* Gila *species were taken into captivity from the Yampa River population and 25 adults from Desolation/Gray population have been brought into captivity to preserve their genetic uniqueness (as recommended, Finney 2006 and Badame 2008, respectively). Populations occurring in Yampa and Cataract Canyons are too small to monitor through mark-recapture analysis; therefore, catch-per-unit-effort information has been recommended to track the status for at least the Cataract Canyon population; juvenile and adult Gila spp. are monitored as a component of the fish community during nonnative fish removal for the Yampa River population.*

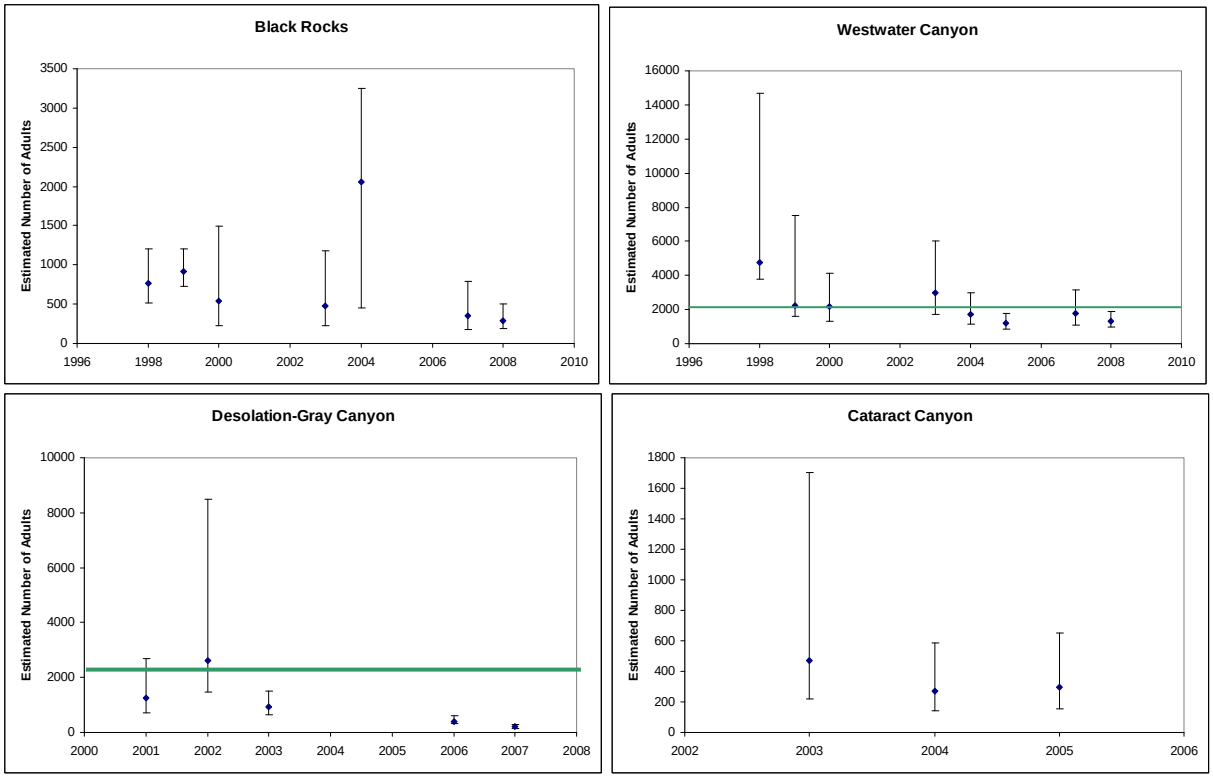


FIGURE 1. Estimated numbers of humpback chub adults (≥ 200-mm TL) in 4 of 5 populations of the Upper Colorado River Basin. Error bars are 95% confidence intervals. The line at 2,100 represents the minimum viable population number; for core populations they need to exceed this level. Data from Black Rocks (McAda 2003a; 2007), Westwater Canyon (Elverud 2008), Desolation/Gray Canyons (P. Badame, Utah Division of Wildlife Resources, pers. comm.), and Cataract Canyon (Badame 2008).

Upper Basin Recovery Unit Criterion 1b: Each of the five self-sustaining populations is maintained over a 5-year period, such that mean estimated recruitment of age-3 (150 to 199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

Status of Upper Basin Recovery Unit Criterion 1b. ***This criterion has not been met****. We do not consider these populations to be self-sustaining, likely as a result of poor recruitment. Too few juveniles are collected during population estimate sampling do to gear type being more selective for adults, i.e., larger fish; and other gear used to select juveniles has had limited success.*

Upper Basin Recovery Unit Criterion 2. One of the 5 populations (e.g., Black Rocks/Westwater Canyon or Desolation/Grey Canyons) is maintained as a core population such that each point estimate exceeds 2,100 adults (Note: 2,100 is the estimated MVP number for a self-sustaining population).

Status of Upper Basin Recovery Unit Criterion 2. ***This criterion has not been met.*** *A presumable core population of humpback chub at either Westwater Canyon/Black Rocks or Desolation/Grey Canyon does not exceed the 2,100 adults necessary to meet the criterion (FIGURE 1).*

Lower Basin Recovery Unit Criterion 1a: The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Service, such that the trend in adult (age-4+; ≥ 200 mm TL) point estimates does not decline significantly.

Status of Lower Basin Recovery Unit Criterion 1a. ***This criterion has been partially met.*** *Population estimates for humpback chub in Grand Canyon are based on an age-structured mark-recapture (ASMR) analysis that uses capture histories from PIT-tagged fish starting in 1989 (FIGURE 2). These estimates are based on models that incorporate uncertainty in age assignment and a mortality rate of 0.13 for age-4+ fish (≥ 200 mm TL; Coggins et al. 2006a; 2006b; Coggins 2008; Coggins and Walters 2009). Earliest estimates are based on small numbers of marks and recaptures and have wider confidence intervals than more recent estimates. These estimates show a decline in the population with the lowest estimate of between about 4,600 and 5,300 age-4+ fish in 2001. Recent estimates suggest that the population of adults may be stabilizing and improving after more than a decade of decline (U.S. Geological Survey 2006; 2007). Between 2001 and 2008, the numbers of adults appear to have increased to an estimated 7,650 adults. The ASMR analysis provides a level of certainty and reliability to the Service for these estimates in determining acceptance. As a result, we can accept these estimates for as far back as they are calculated and consider the population to be self-sustaining.*

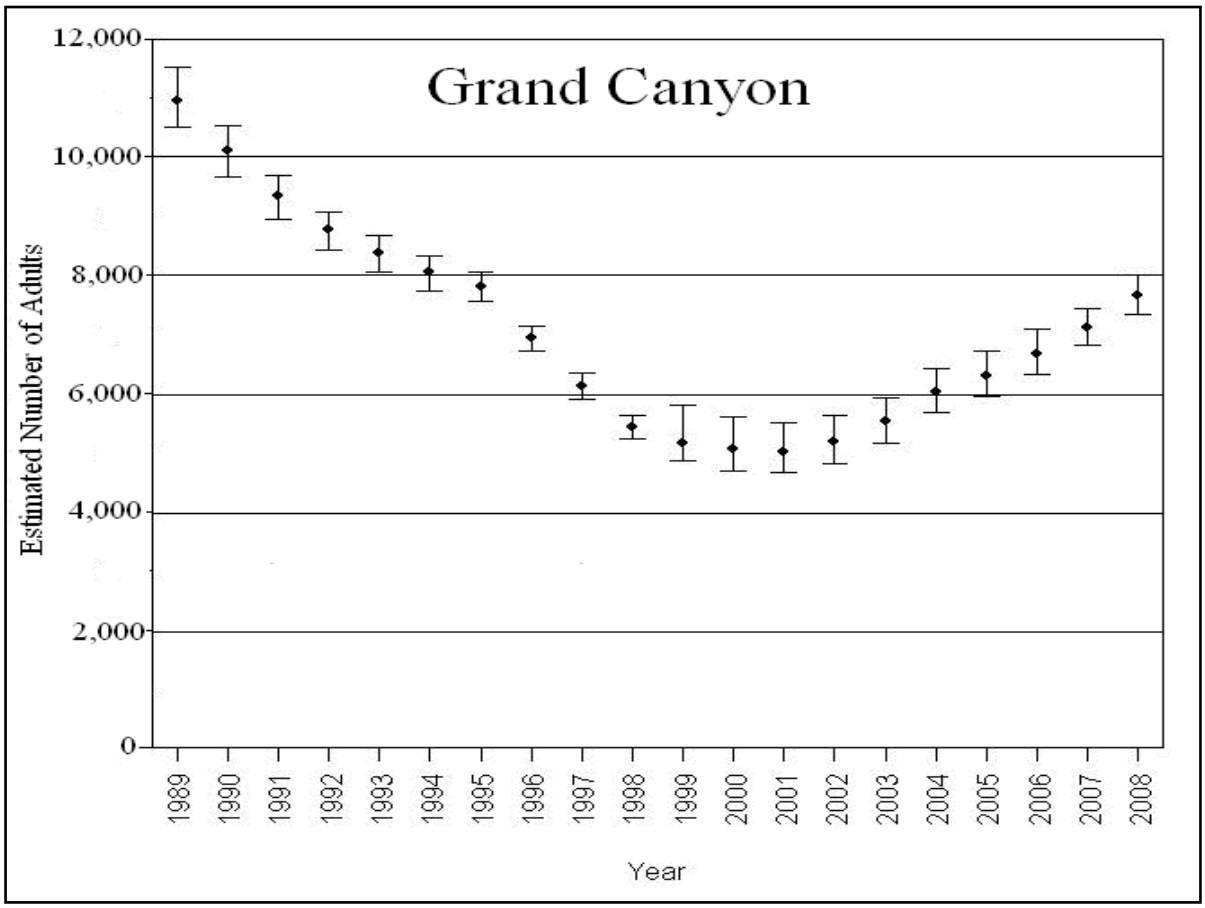


FIGURE 2. Estimated numbers of humpback chub adults (≥ 200-mm TL) in the Grand Canyon population of the Lower Colorado River System. Error bars are a range of estimates from Monte Carlo simulations (Coggins and Walters 2009.)

Lower Basin Recovery Unit Criterion 1b: The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Service, such that mean estimated recruitment of age-3 (150 to 199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

Status of Lower Basin Recovery Unit Criterion 1b. ***This criterion has been partially met.*** *In 2005, scientists also detected more juveniles (age-1 to age-3+) and young-of-year than previous years indicating good future recruitment. The increase in adult abundance appears to be driven by a gradual increase in recruitment since the mid to late 1990s. However, simulation results suggest that this apparent gradual increase in recruitment is quite possibly an artifact of ageing error causing recent strong cohorts to be incorrectly assigned to earlier brood-years.*

Lower Basin Recovery Unit Criterion 1c: The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Service, such that each core population point estimate exceeds 2,100 adults (MVP).

Status of Lower Basin Recovery Unit Criterion 1c. ***This criterion has been met.*** *The estimate of adults in this population has never been below 4,600. A population of 7,650 means this core population exceeds the MVP of 2,100. We can accept these estimates for as far back as they are calculated and consider the population to be self-sustaining.*

RECOVERY FACTOR DOWNLISTING CRITERIA FOR HUMPBACK CHUB TO MINIMIZE OR REMOVE THREATS TO THE SPECIES

UPPER BASIN RECOVERY UNIT

Factor A—Adequate habitat and range for recovered populations provided.

Streamflow regulation and associated habitat modification are primary threats to humpback chub populations. Reservoir inundation, cold-water releases from dams, streamflow alteration, changes in channel geomorphology, and modification of sediment transport have impacted habitat of the native Colorado River fishes, including the humpback chub. Dams were considered a major threat to the humpback chub at the time of listing; however, construction of new dams affecting occupied habitat ceased nearly 4 decades ago. Changes in channel geomorphology of habitat occupied by humpback chub are not extensive because most habitat occurs in rocky canyon-confined reaches with low susceptibility to geomorphic modification.

Maintenance of streamflow is important to the ecological integrity of large western rivers. Flow recommendations have been developed for some river systems in the Upper Colorado River Basin that identify and describe flows with the necessary magnitude, frequency, duration, and timing to benefit the endangered fish species (Modde et al. 1999; McAda 2003; Muth et al. 2000).

Criterion 1. Flow regimes to benefit humpback chub populations in the upper Colorado, Green, and Yampa Rivers should be identified, implemented, evaluated, and revised, such that:

a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria.

b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria.

c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria.

Status of Criterion 1. ***Criterion 1 has been partially met.*** *Flow recommendations have been developed for the Green River (Muth et al. 2000); Yampa River (Modde et al. 1999), and upper Colorado River (McAda 2003b). These flow recommendations are primarily for Colorado pikeminnow and razorback sucker, but are believed to benefit the humpback chub in sections below the reaches of interest. These flow recommendations are still being evaluated and modified annually through adaptive management.*

Factor B—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

Overutilization of humpback chub for commercial, recreational, scientific, or educational purposes is not currently considered a threat to the species. Humpback chub have no commercial or recreational value and are not sought by commercial fishermen or anglers. Collection of humpback chub for scientific or educational purposes is regulated by the Service under the Act.

Criterion 2. Overutilization of humpback chub for commercial, recreational, scientific, or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 2. ***Criterion 2 has been met.*** *No commercial or recreational activities exist. Educational activities are minimal and do not threaten humpback chub. Scientifically, reduced survival of adult humpback chub as a result of handling has not been proven, and delayed mortality due to sampling has not been demonstrated.*

Factor C—Adequate protection from diseases and predation.

Diseases and parasites currently are not considered to be significant in the decline of the humpback chub in the upper basin.

The threat of predation by nonnative fishes on humpback chub has been recognized in two populations in the upper basin. Channel catfish (*Ictalurus punctatus*) are the principal predator of humpback chub in Desolation/Gray Canyons (Chart and Lentsch 2000) and Yampa Canyon (Upper Colorado River Endangered Fish Recovery Program 1999). Control of the release and escapement of nonnative fishes into the mainstem, floodplain, and tributaries is a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous nonnatives from riverside features. Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish (*Lepomis cyanellus*), black bullhead (*Ameiurus melas*), largemouth bass (*Micropterus salmoides*), and other nonnative fishes that may escape to the river during high flows (Valdez and Wick 1983). Three management actions are identified to reduce the threat of nonnative fishes: high spring flows, nonnative fish control strategies, stocking agreements. Active control programs should be implemented or continued (as needed) for problematic nonnative fishes in Yampa Canyon and Desolation/Gray Canyons.

Criterion 3. Effects of diseases and parasites on humpback chub populations should be reevaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 3. ***Criterion 3 has not been met.*** *The effects of disease and parasites on humpback chub populations have not been re-evaluated.*

Criterion 4. Procedures should be developed, implemented, evaluated, and revised for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and humpback chub.

Status of Criterion 4. ***Criterion 4 has been met.*** *Procedures were developed in 1996 and modified in 2009 (Service 1996; 2009). The Procedures distinguish between stocking nonnative salmonids and non-salmonids and have specific requirements for stocking locations related to their proximity to critical habitat.*

Criterion 5. Channel catfish control programs should be developed and implemented to identify levels of control that would minimize predation on humpback chub in Yampa Canyon and Desolation/Gray Canyons.

Status of Criterion 5. ***Criterion 5 has been partially met.*** *A level of control of channel catfish has been identified, but superceded by actions to remove or minimize predation and competition effects of small mouth bass (Fuller 2006; Haines and Modde 2007). The level of channel catfish control needs to be evaluated and reviewed.*

Factor D—Adequate existing regulatory mechanisms.

Implementation of regulatory mechanisms is necessary for recovery of the humpback chub and to ensure long-term conservation of the species. After removal from the list of species protected by the Act, the humpback chub and its habitat will continue to receive consideration and some

protection through the following Federal laws and related state statutes: National Environmental Policy Act; Clean Water Act; Organic Act; and Fish and Wildlife Coordination Act.

The need for conservation plans and agreements was identified to provide reasonable assurances that recovered humpback chub populations will be maintained.

Criterion 6. Regulatory mechanisms determined adequate for legal protection of adequate habitat are identified.

Status of Criterion 6. ***Criterion 6 has been partially met.*** *Filing for legal rights to protect water for fish would be junior to the legal rights of others who have already claimed water for irrigation and power. Utah is currently reviewing the water rights from Flaming Gorge and how they may be modified for fish protection. Other legal options that could be employed are leasing water (Steamboat Reservoir) or contractual commitments (Wolford and Elkhead Reservoirs). In addition, 60,000 acre-feet on the upper Colorado River from the Historic Users Pool (reservoir projects built prior to the Recovery Program, i.e., 1988) are used to maintain river flows in the 15-mile reach (from Palisade to the confluence of the Gunnison River) as written in a programmatic biological opinion.*

Criterion 7. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of humpback chub populations.

Status of Criterion 7. ***Criterion 7 has not been met****. Conservation plans and the necessary elements have not been developed.*

Factor E—Other natural or manmade factors for which protection has been provided.

Humpback chub, bonytail (*Gila elegans*), and roundtail chub (*Gila robusta*) are sympatric Colorado River mainstem species with substantial evidence of introgressive hybridization (Dowling and DeMarais 1993).

The potential role of pesticides and pollutants in suppressing populations of *Gila* were discussed by Wick et al. (1981). Potential spills of hazardous materials threaten some populations of humpback chub. All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills.

Criterion 8. State and Federal hazardous-materials spills emergency-response plans should be reviewed and modified to ensure adequate protection for humpback chub populations from hazardous-materials spills.

Status of Criterion 8. ***Criterion 8 has not been met.*** *The hazardous-materials spills emergency-response plans have not been reviewed or modified.*

Criterion 9. Measures should be identified to minimize the risk of hazardous-materials spills in Black Rocks and Westwater Canyon from transport of materials along the adjacent railway.

Status of Criterion 9. ***Criterion 9 has not been met.*** *No measures have been identified to minimize the risk of hazardous materials spills in Black Rocks and Westwater Canyon from materials transported along railway.*

Criterion 10. Locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat should be identified and the need for emergency shut-off valves assessed.

Status of Criterion 10. ***Criterion 10 has been partially met.*** *Although some progress has been made in locating all petroleum-product pipelines, determination of emergency shut off valves has not been assessed. New pipelines crossing rivers are required to have shut-off valves.*

LOWER BASIN RECOVERY UNIT

Factor A—Adequate habitat and range for recovered populations provided.

An Environmental Impact Statement in 1995, with a Record of Decision in 1996, established releases from Glen Canyon Dam that will be evaluated through adaptive management to protect resources of the Colorado River through Grand Canyon (U.S. Department of the Interior 1995).

Criterion 1. Life stages and habitats of humpback chub in the mainstem Colorado River should be identified and the relationship between individuals in the mainstem and the Little Colorado River should be determined.

Status of Criterion 1. ***Criterion 1 has been met****. Greatest movement of humpback chub has been reported from Grand Canyon, primarily because adults from the mainstem annually ascend the Little Colorado River to spawn (Valdez and Ryel 1995; Paukert et al. 2006). Average movement of 401 PIT-tagged fish marked in the mainstem and recaptured in the Little Colorado River was 7.2 km (range, 0.08 to 34.1 km). However, most of these fish returned to the mainstem with remarkable fidelity to mainstem locales. Of 60 PIT-tagged fish consecutively captured in the mainstem, then the Little Colorado River, and again in the mainstem, 54 (90%) returned to within 2 km of their original mainstem locale; 31 (52%) were recaptured within 0.5 km; and 10 (17%) were recaptured within 0.1 km. No significant difference in movements was noted between male and female humpback chub. Fish moving from the mainstem to the Little Colorado River and back to the mainstem tended to be larger fish than those remaining in the Little Colorado River (81% were >300 mm TL). Paukert et al. (2006) found similar fidelity with several fish moving more than 154 km throughout Grand Canyon between capture and recapture.*

Criterion 2. Operations of Glen Canyon Dam to benefit humpback chub in the Colorado River through Grand Canyon should be continued and a flow regime to benefit humpback chub in the Little Colorado River should be identified, implemented, evaluated, and revised, such that:

a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

b. Adequate nursery habitat is available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

Status of Criterion 2. ***Criterion 2 has been partially met****. In 2008, the Service issued a new biological opinion on the operation of Glen Canyon Dam. That opinion replaced the 1995 opinion and determined that implementation of the March 2008 high flow test and the 5-year implementation of Modified Low Fluctuating Flows with steady releases in September and October was not likely to jeopardize the continued existence of the humpback chub and was not likely to destroy or adversely modify designated critical habitat. The 2008 biological opinion contained conservation measures that include: 1) a reconsultation trigger if the population of adult humpback chub (≥200 mm TL) in Grand Canyon declines significantly, or, if in any single year, based on the ASMR model (Coggins 2008), the population drops below 3,500 adult fish within the 95% confidence interval; 2) development of a Comprehensive Plan for the Management and Conservation of Humpback Chub in Grand Canyon; 3) humpback chub translocations; 4) implementation of nonnative fish control; 5) humpback chub nearshore ecology study; 6) monthly flow transition study; 7) creation of a humpback chub refuge population; and 8) initiation of a Little Colorado River watershed plan. As the result of a lawsuit filed by the Grand Canyon Trust, a Federal Court Judge ruled that the 2008 opinion was a departure from the Service's prior position and ordered the Service to revise the opinion by October 31, 2009. The opinion was adequately explained and the conservation measures in the opinion were accepted by the court on March 30, 2011.*

The Little Colorado River Watershed Coordinating Council was formed in 2007 to help coordinate water management activities within the Little Colorado River. The Council has a Water Quality Improvement Grants program that provides interested parties with Federal grants to improve water quality in the Little Colorado River watershed.

Criterion 3. Effects and feasibility of a temperature control device for Glen Canyon Dam to increase water temperatures in the mainstem Colorado River through Grand

Canyon that would allow for range expansion of humpback chub should be determined.

Status of Criterion 3. ***Criterion 3 has been met****. A risk assessment and scoping environmental assessment for a temperature control device on the penstocks at Glen Canyon Dam have been completed (U.S. Bureau of Reclamation 2004).*

Factor B—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

Overutilization of humpback chub for commercial, recreational, scientific, or educational purposes is not currently considered a threat to the species. Humpback chub have no commercial or recreational value and are not sought by commercial fishermen or anglers. Collection of humpback chub for scientific or educational purposes is regulated by the Service under the Act.

Criterion 4. Overutilization of humpback chub for commercial, recreational, scientific or educational purposes should be reevaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 4. ***Criterion 4 has been met.*** *No commercial, recreational or educational activities exist. Scientifically, reduced survival of adult humpback chub as a result of handling has not been proven, and delayed mortality due to sampling has not been demonstrated. Hunt (2008) concluded trammel netting as a sampling technique should be avoided at temperatures at or above 20ºC. The effects appeared much worse for hatchery-produced razorback sucker and bonytail than for wild roundtail chub. It's assumed that wild humpback chub would be similar to wild roundtail chub.*

Factor C—Adequate protection from diseases and predation.

Meretsky et al. (2000) hypothesized that an observed decline in condition of adult humpback chub in Grand Canyon was a result of recent infestation by the internal Asian tapeworm (*Bothriocephalus acheilognathi*).

Criterion 5. An Asian tapeworm control program should be developed and implemented in the Little Colorado River to identify levels of control that will minimize the negative effects of parasitism on the humpback chub population.

Status of Criterion 5. ***Recovery Factor Criterion 5 has been met.*** *Ward (2007) developed protocols for treating humpback chub for Asian tapeworm. Arizona Game and Fish Department is implementing those protocols (Clark et al. 2008).*

The threat of predation by nonnative fishes on humpback chub has been recognized in Grand Canyon population. Brown trout (Salmo trutta), channel catfish, black bullhead, and rainbow trout (Oncorhynchus mykiss) have been identified as principal predators of juvenile humpback chub, with estimates that

suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Studies from the lower Colorado River through Grand Canyon (Hoffnagle et al. 1999; Valdez et al. 2001) showed reductions in densities of small-bodied species of fish (e.g., fathead minnow [Pimephales promelas], red shiner [Cyprinella lutrensis], plains killifish [Fundulus zebrinus]) following high flows. High releases from Glen Canyon Dam in 1996 (Hoffnagle et al. 1999; Valdez et al. 2001) and in 2000 (Trammell et al. 2001) significantly reduced numbers of red shiner, fathead minnow, and plains killifish with no decline in native species. A strong year class of humpback chub in Grand Canyon in 1993 followed high early spring-runoff flows from the Little Colorado River, and was attributed to cleansing of spawning gravels and short-term reduction in nonnative fishes (Gorman 1994).

Citerion 6. Procedures should be developed, implemented, evaluated, and revised for stocking and to minimize escapement of nonnative fish species into the Colorado River and its tributaries through Grand Canyon to minimize negative interactions between nonnative fishes and humpback chub.

Status of Criterion 6. ***Criterion 6 has not been met.*** *No procedures have been developed.*

Criterion 7. Rainbow trout, channel catfish, black bullhead, and common carp control programs should be developed and implemented to identify levels of control that will minimize predation on humpback chub in the Little Colorado River.

Status of Criterion 7. ***Criterion 7 has been partially met.*** *The percentage of nonnative fishes in the Little Colorado River remains at low levels (Ward and Persons 2007). The number of fathead minnows has increased since 1994, although trends are difficult to assess due to high variability in catch rate between years. Ward and Persons (2007) concluded, if the mainstem Colorado River continues to be warm, fathead minnow and red shiner may be able to become established in the mainstem and invade the Little Colorado River between flood events much more quickly. Black bullhead and channel catfish catch rates have been highly variable in recent years, although they have been increasing since 2002. Common carp do not show any trends; however, adult common carp are not very susceptible to capture in hoop nets.*

Criterion 8. Brown trout and rainbow trout control programs should be developed and implemented to identify levels of control that will minimize predation on humpback chub in the Colorado River through Grand Canyon.

Status of Criterion 8. ***Criterion 8 has been partially met.*** *Mechanical removal of brown trout and rainbow trout around the confluence occurred from 2003-2008. Although a declining catch rate was identified over the 5-year period an identified level of control has not been determined.*

Factor D—Adequate existing regulatory mechanisms.

Implementation of regulatory mechanisms is necessary for recovery of the humpback chub and to ensure long-term conservation of the species. After removal from the list of species protected by the Act, the humpback chub and its habitat will continue to receive consideration and some protection through the following Federal laws and related state statutes: National Environmental Policy Act; Clean Water Act; Organic Act; and Fish and Wildlife Coordination Act.

The need for conservation plans and agreements was identified to provide reasonable assurances that recovered humpback chub populations will be maintained.

Criterion 9. Mechanisms determined adequate for legal protection of adequate habitat in the mainstem Colorado River through Grand Canyon and the Little Colorado River should be developed.

Status of Criterion 9. ***Criterion 9 has been met.*** *The Grand Canyon Protection Act along with "law of the river," including interstate compacts, provide flows through Grand Canyon to deliver to lower basin states and benefit the ecosystem overall. The Glen Canyon Dam Adaptive Management Work Group through its Technical Work Group and the biological opinion for the reoperation of Glen Canyon Dam is the mechanism in which these flows are protected and provided.*

A Little Colorado River watershed study is a basin-wide effort to define the problems, identify solutions and options related to protecting and increasing water supplies, preserve/enhance a more natural environment, and improve the health of the watershed. There are multiple jurisdictions over the water resources that are working to develop a coordinated management plan to optimize the water resources to meet the water needs.

Criterion 10. Elements of conservation plans are identified that are necessary to provide for the long-term management and protection of humpback chub populations.

Status of Criterion 10. ***Criterion 10 has not been met.*** *Conservation plans and the necessary elements have not been developed.*

Factor E—Other natural or manmade factors for which protection has been provided.

The potential role of pesticides and pollutants in suppressing populations of *Gila* were discussed by Wick et al. (1981). Potential spills of hazardous materials threaten some populations of humpback chub. All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills. A preventive measure may include filtration systems in case of accidental spills of hazardous materials at the Cameron bridge crossing above occupied habitats.

Criterion 11. State and Federal hazardous-materials spills emergency-response plans should be reviewed and modified to ensure adequate protection for humpback chub populations from hazardous-materials spills.

Status of Criterion 11. ***Criterion 11 has not been met.*** *The hazardous-materials spills emergency-response plans have not been reviewed or modified.*

Criterion 12. Measures should be identified to minimize the risk of hazardous-materials spills from transport of materials along U.S. Highway 89 at and near the two Cameron bridges spanning the Little Colorado River.

Status of Criterion 12. ***Criterion 12 has not been met.*** *No measures have been identified to minimize the risk of hazardous materials spills in along U.S. Highway 89 and near the Cameron bridge spanning the Little Colorado River from materials transported along roadway.*

2.3 Synthesis

Recovery is based on reduction or removal of threats and improvement of the status of a species during the period in which it is listed, and not just from the time a listed species is proposed for reclassification. Environmental conditions and the structure of populations change over time, and threats recognized at listing or in subsequent recovery plans may no longer be directly applicable when reclassification is considered. Management actions and tasks identified for listed species are expected to minimize or remove threats and improve the species' status.

Recovery is achieved when management actions and associated tasks have been implemented and/or completed to allow genetically and demographically viable, self-sustaining populations to thrive under minimal ongoing management and investment of resources. Achievement of recovery does not mandate returning a species to all or a significant portion of its historic range, nor does it mandate establishing populations in all possible habitats, or everywhere the species can be established or reestablished.

At the time of listing, habitat losses were documented but the threats to humpback chub were poorly understood and distribution and abundance of the species were not well known. The decline of the species was probably a combination of threats, including direct loss of habitat and changes in flow and temperature. In addition, interaction with nonnative fish may have had a decimating effect in waters not affected by dams. Humpback chub is adapted to life in deep, canyon-bound reaches of the Green, Colorado, and Little Colorado Rivers.

Recovery of humpback chub is considered basinwide with the basin being separated into an upper basin and lower basin recovery unit. The analysis above of the demographic criteria has shown: 1 of the 6 downlisting demographic sub-criteria has been met, 2 have been partially met, and 3 have not been met (TABLE 1). From the above list of recovery factor downlisting criteria in the upper basin: 2 of the 10 have been met; 4 have been partially met, and 4 have not been met. In the lower basin: 2 of the 12 downlisting recovery factor criteria

have been met; 6 have been partially met, and 4 have not been met. Although the category "has been partially met" is identified, this is only to reflect that some progress is being made on that particular criterion. Since the majority of demographic (5 out of 6) and recovery factor dowlisting criteria (4 out of 22) have not been met, no change in the endangered status of humpback chub is recommended. The definition of endangered applies here until the demographic criteria are met and the threats minimized or removed.

TABLE 1. Summary of the downlisting demographic and recovery factor criteria by recovery unit basin and a determination if the criteria have been met, partially met or not met for analyzing whether humpback chub can be downlisted.

CRITERIA FOR DOWNLISTING	HAS BEEN MET	HAS BEEN PARTIALLY MET	HAS NOT BEEN MET
Demographic			
Upper Colorado River Subbasin			1a, 1b, 2
Lower Colorado River Subbasin	1c	1a, 1b	
Upper Basin Recovery Factors			
Recovery Factor A		1	
Recovery Factor B	2		
Recovery Factor C	4	5	3
Recovery Factor D		6	7
Recovery Factor E		10	8, 9
Lower Basin Recovery Factors			
Recovery Factor A	1, 3	2	
Recovery Factor B	4		
Recovery Factor C	5	7, 8	6
Recovery Factor D	9		10
Recovery Factor E			11, 12

3.0 RESULTS

3.1 Recommended Classification

_X_ **No change is needed**

3.2 New Recovery Priority Number: We do not recommend a change in the Recovery Priority Number. The degree of threat is high, with a high degree of recovery potential representing a species, which falls under the 2C category for a recovery priority number according to the "Endangered and threatened species listing and recovery priority guidance" (48 FR 43098).

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The Upper Colorado River Endangered Fish Recovery Program along with the Glen Canyon Dam Adaptive Management Program (a conservation program to restore the Grand Canyon ecosystem) continue working to meet the recovery factor criteria to minimize or remove threats to the humpback chub in their respective recovery units. These programs develop annual work plans through adaptive management (Recovery Implementation Program Recovery Action Plan and Annual Budget and Work Plan, respectively), to minimize and remove threats to the humpback chub and thus achieve the recovery factor criteria. By meeting these recovery factor criteria, the demographics of the species should improve. The improvement in demographics is evidenced by the lower basin having 75% (8 out of 12) of the recovery factor criteria met or partially met, along with an increasing trend in adult abundance. In particular, the nonnative fish control actions that have been taken and the increased water temperatures as a result of lower Lake Powell levels have improved the status of the species in the lower basin recovery unit.

The recovery goals are currently being revised based on new information since their publication in 2002. Subsequently, the recovery plans will be revised.

Uncertainty surrounding the effects of climate change to the humpback chub should be considered for each of the threats as those impacts are realized. For example, the potential for alteration of flows in the basin as a result of climate change should at least be mentioned in the recovery goals. Climate change could have large impacts on the basin's aquatic ecosystem, resulting in (but not limited to):

- Change in the timing of peak flows due to altered snowmelt patterns;
- Change in runoff peaks due to increased inter-annual variation in snowpack formation; and
- Change in water temperatures due to altered air temperatures.

Not only would climate change affect the ecology of the species because of the factors listed above, but it also would greatly affect the management of the programs through changes in politics and economics, such as:

- Greater evaporation losses in the larger reservoirs may reduce flexibility of operations; and
- Drier conditions in the basin may cause irrigators to call on their water rights more often or request more water rights.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Humpback chub*

Current Classification:

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Review Conducted By: Upper Colorado River Endangered Fish Recovery Program Office

FIELD OFFICE APPROVAL:

Thomas E. Chart, Program Director, Fish and Wildlife Service
Upper Colorado River Endangered Fish Recovery Program Office

Approve _____ Date 1/26/2011
Thomas E. Chart, Program Director

REGIONAL OFFICE APPROVAL:

Steve Guertin, Regional Director, Mountain-Prairie Region (6)
Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 2/15/2011

OTHER REGIONAL OFFICES (within range of species)

Dr. Benjamin Tuggle, Regional Director, Southwest Region (2)
Cooperating Regional Director, Fish and Wildlife Service

__X__ Concur _____ Do Not Concur

Signature _____ Date 7/22/11

Michael Fris, Assistant Regional Director, Pacific Southwest Region (8)
Cooperating Assistant Regional Director, Ecological Services

__X__ Concur _____ Do Not Concur

Signature _____ Date 8/12/11

Biennial Budget and Work Plan (FY 2013-14)

- Comments from TWG after Feb. 2 meeting
- BAHG review, additions, discussion
- BAHG final Feb. 14
- 51 comments plus 4 policy level (AMWG guidance needed)

- Consider KA II updates
- Consider 2 EAs, BIOP
- Annual reports

POLICY ISSUE

- Review of distribution and status of missing and at risk species -$50,000
- Placeholder added for reintroducing extirpated species in Grand Canyon

Request consideration related to AMP policy, RIN 3.1.1 states no use of AMP funds for extirpated species work (category C information need)

AMWG acknowledged species of concern white paper in August 2011

2 EAs and BiOp (10)

- Clearly identify compliance needs for these actions and make them a high priority, including tribal perspectives
- Identify and mitigate adverse effects to traditional cultural properties
- Restructure budget to better incorporate the compliance needs for HFEs
- Integration of tribes, TEK, into monitoring program related to these actions
- Rapid Response science plan to contrast store and release
- Lack of funding for riparian and cultural/archaeology monitoring may make compliance with NHPA difficult
- Consider HFE monitoring in the core monitoring plan

Humpback Chub (9)

- Consider humpback chub comprehensive plan
- Consider humpback chub restoration study (100k)
- Consider how to minimize research sampling impacts to aggregations
- Support for PBR study, coordinate results with TWG
- Clarity on annual incidental take monitoring related to new ITS, and provide annual updates on take
- Chute Falls translocation plan requested
- Support brown trout removal in mainstem and BA

Humpback Chub (continued)

- Clear link between budget and core monitoring plan to support and evaluate progress to recovery
- How can the program achieve goals described in the status review and further described by FWS?
- Has carrying capacity been reached (in the LCR), and if so, what can be done to achieve goals?
- Are we on track for being able to evaluate when goals are reached?

Native American Values & TEK (5)

- Concern that the AMP is losing sight of humanistic values associated with Grand Canyon and the Colorado River ecosystem
- Lack of presented information regarding Native American issues was a significant information need not covered during the KA II process
- Use un-used funds to support tribal concerns
- DOI should include a project/program in 13-14 budget to consider how to integrate TEK into GCMRC, (50k)

Riparian Vegetation (4)

- Riparian vegetation model development
- Given significance of riparian changes, study vegetation to understand impacts to sediment retention/sand bars
- Funding isn't sufficient to address:
  - Continuation of past data sets
  - Synthesizing past monitoring
  - Monitoring encroachment on sand bars

TWG Management (3)

- Consider meetings in locations that allow contact with the resources we are considering, to include stakeholder values
- Allow adequate funding to have meetings and connection to the resource
- Consider river trip in 13-14 budget

Other Categories

- Refinement of ecosystem models
- Use of Cataract Canyon (or other areas) as a control
- Reclamation should define compliance responsibility under 1994 PA and 2007 treatment plan, and complete NHPA compliance
- Concerns over arch. site preservation, and values associated with it
- Too much focus on sediment suspension and transport if it primarily is used to build sand bars that erode quickly, revisit needs

Other Categories (cont'd)

- Lees Ferry gravel pits ecosystem study feasibility analysis
- Re-consider need to monitor old high water zone
- Nutrient dynamics model pilot study
- Study RBT/native fish dynamics in Shinumo Creek
- AMP administrative history study
- Consider what could be learned from floods >60k cfs
- Emphasize timely research results, more funds?

Other Categories (cont'd)

- Maintain research focus on dam operations needs for compliance
- Consider restructuring budget to meet goals such as nonnative fish and HFEs and removing “Experimental Flow Fund” line item, general reconsolidation of budget to clarify