# GENETICS MANAGEMENT PLAN

# for

# HUMPBACK CHUB (*Gila cypha*)

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**DRAFT 1**

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## INTRODUCTION

A perceived decline in the Grand Canyon humpback chub population in 2002 raised concern over genetic viability, and a possible need was identified to take the species into a refuge or captive propagation program. There was also concern expressed regarding genetic ramifications when creating small founder populations by translocations into tributaries to the Grand Canyon. In response to concerns about the status of humpback chub, Glen Canyon Dam Adaptive Management Work Group formed an Ad Hoc Committee to consider actions to implement a comprehensive research and management program for the humpback chub. Although the comprehensive plan is still in draft, it identifies a genetics management plan for humpback chub to determine genetic relationships within and among populations of the endangered *Gila cypha* (humpback chub) in the Colorado River ecosystem (http://137.77.133.1/uc/envprog/amp/amwg/mtgs/04oct25/HBC_Projects.pdf), further genetics research on humpback chub gentics is being conducted at Colorado State University and is due out by the end of this year. The U.S. Fish and Wildlife Service was requested to develop a genetics management plan for humpback chub in the Colorado River Basin in order to identify and direct research and management actions needed to ensure current genetic diversity and viability of humpback chub are preserved as actions are taken to recover the species.

## HUMPBACK CHUB SPECIES STATUS

Six extant populations of humpback chub exist (Yampa Canyon, Desolation/Gray canyons, Black Rocks, Westwater Canyon, Cataract Canyon, and Grand Canyon). Similar morphometric and meristic characteristics among the six populations of *Gila cypha* (Douglas et al. 1998, 2001; McElroy and Douglas 1995; McElroy et al. 1997) and lack of genetic differentiation among the six populations suggest panmixis and extensive introgression with sympatric *Gila* species (Dowling and DeMaris 1993).

The most current estimates of the mean number of wild adult humpback chub (greater than 200 mm total length) are provided below. Information on Upper Colorado River Basin populations was gathered from presentations at the August 2004 population estimates workshop. Many of these estimates are preliminary (analyses ongoing), and some are contained in draft reports undergoing peer and Biology Committee review. These data indicate recent downward trends in the abundance of humpback chub in Black Rocks, Westwater Canyon, and Desolation/Gray Canyons. Information on the Grand Canyon population in the Lower Colorado River Basin is provided by Grand Canyon Research and Monitoring Center, through the use of an Age-Structured Mark Recapture program.

Table 1. Current humpback chub population estimates with confidence intervals.

| Population | Year | Estimate | Confidence Interval | Author/Method |
|---|---|---|---|---|
| Yampa Canyon | 1998–2000 | 400 | 100–2000 | B. Haines & T. Modde, Likelihood Density Function |
| Desolation/Gray canyons | 2001<br>2002<br>2003 | 1,254*<br>2,612*<br>937* | 733–2,697*<br>1,477–8,509*<br>636–1,520*† | J. Jackson et al., Closed Mark-Recapture |
| Black Rocks | 1998<br>1999<br>2000<br>2003 | 764<br>921<br>539<br>500* | 512–1,206<br>723–1,208<br>223–1,497<br>221–1,176* | C. McAda, Closed Mark-Recapture |
| Westwater Canyon | 1998<br>1999<br>2000<br>2003 | 4,744<br>2,215<br>2,201<br>2,413* | 37,60–14,665<br>1,608–7,508<br>1,335–4,124<br>1,500–4,396* | J. Jackson, Closed Mark-Recapture |
| Cataract Canyon | 2003 | 150* | 71–407* | P. Badame, et al., Closed Mark-Recapture |
| Grand Canyon | 2004 | 2,000–4,000 | | L. Coggins, Age Structure-Mark Recapture |

* Preliminary data.
† Sampling season switched to fall from summer.

The recovery goals for humpback chub (U.S. Fish and Wildlife Service 2002) discuss the concept of redundancy and core populations:

> "Humpback chub occur as multiple, demographically independent populations in widely distributed regions of the Colorado River Basin; distances of 17–394 km separate adjacent populations. This widely clumped distribution pattern contributes to redundancy as species protection against threats and catastrophic events. The five populations in the upper basin occur in discrete regions of three subbasins, including three populations in the Colorado River, and one population each in the Green River and Yampa River. The lower basin population in Grand Canyon exists independently downstream of Glen Canyon Dam, where it has been geographically isolated from upper basin populations since dam construction in 1963. This pattern of geographic separation among all six populations provides population redundancy and greatly reduces the likelihood of a catastrophic event simultaneously affecting the majority of populations.

> It is recognized that the six populations of humpback chub vary considerably in size, from about 400 to 5,000 adults. The larger populations are considered "core populations". A core population is an independent self-sustaining population sufficiently large to maintain genetic and demographic viability. A core population may serve as a center of dispersal from which new populations are established or existing populations are augmented. Core populations are sufficiently large and viable to protect against extreme demographic and environmental variability. A core population may consist of two or more geographically proximate populations (e.g., Black Rocks and Westwater Canyon). In case of a catastrophe, multiple or redundant core populations preserve species viability."

Despite a current downward trend (not statistical) in adult humpback chub population estimates in the past few years, if the estimates of all humpback chub populations were summed there would be between 5,000 and 10,000 adults in the Colorado River Basin. The current population trend may be caused by recent drought during the late 1990's and early part of 2000, although there is some indication that some of the population declines may have been occurring before the drought conditions. Reduced streamflows have also allowed for an expansion of nonnative fish species which compete with and prey upon the native fishes.

## UPPER COLORADO RIVER BASIN GENETICS MANAGEMENT PLAN

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) philosophy and mission for genetics management of endangered fishes are to:

1. Maintain the genetic integrity of wild endangered fish stocks in the upper basin; and

2. Maintain genetic diversity in captive broodstocks that is similar to the stock used as founders.

The goals of this genetics management plan are to:

1. Conserve genetic diversity of wild endangered fish populations while implementing recovery efforts that will maintain, enhance, or reestablish viable wild populations by removing or significantly reducing factors that caused population declines;

2. Maintain genetic diversity in captive-reared endangered fish broodstock that is similar to that of the wild population used as founders; and

3. Produce genetically diverse fish for augmentation efforts.

According to the current Genetics Management Plan (Czapla 1999), the humpback chub was assigned "Priority 3" among the four endangered species because the populations were considered stable but small and localized in deep canyon river reaches. Within the species,

populations were prioritized as follows (the Grand Canyon population was not considered in the plan):

| Priority | Population - Reason |
|---|---|
| 1 | Desolation-Gray Canyon - because of small numbers of fish, morphological variation, and remoteness in the upper basin. |
| 2 | Yampa Canyon - because it is located in the relatively unaltered Yampa River. Concern of nonnative fish predation impacting this population is currently under investigation. |
| 3 | Cataract Canyon - because the phenotypes indicate the population is not as variable as the Yampa River and Desolation-Gray Canyon population and is less likely to be impacted from human activities. |
| 4 | Black Rocks - because the phenotypes indicate a pure humpback chub population. Westwater Canyon - because the phenotypes appear to be pure humpback chubs like the Black Rocks Canyon population. Black Rocks and Westwater Canyon populations were considered relatively large and stable and assigned the lowest priority. |

## SERVICE POLICY ON CAPTIVE PROPAGATION

A joint policy with U.S Fisha and Wildlife Service and National Maine Fisheries Service regarding controlled propagation of species (U.S Office of Federal Register 65:183 [2000]: 56916–56922) "addresses the role of controlled propagation in the conservation and recovery of species listed as endangered or threatened under the Endangered Species Act of 1973 (as amended) (Act). The policy provides guidance and establishes consistency for use of controlled propagation as a component of a listed species recovery strategy. This policy will help to ensure smooth transitions between various phases of conservation efforts such as propagation, reintroduction and monitoring, and foster efficient use of available funds. The policy supports the controlled propagation of listed species when recommended in an approved recovery plan or when necessary to prevent extinction of a species. Appropriate uses of controlled propagation include supporting recovery related research, maintaining refuge populations, providing plants or animals for reintroduction or augmentation of existing populations, and conserving species or populations at risk of imminent extinction or extirpation."

The policy further states: "Controlled propagation is not a substitute for addressing factors responsible for an endangered or threatened species' decline. Therefore, our first priority is to recover wild populations in their natural habitat wherever possible, without resorting to the use of controlled propagation. This position is fully consistent with the Act."

There is no mention in this policy that when wild populations fall to a certain level or number that they must be brought into captivity.

*Status of Captive Propagation of current endangered fish species:*

The captive propagation policy clearly states "Our policy is that the controlled propagation of threatened and endangered species will be: 1. **[First]** Used as a recovery strategy only when other measures employed to maintain or improve a listed species' status in the wild have failed, are determined to be likely to fail, are shown to be ineffective in overcoming extant factors limiting recovery, or would be insufficient to achieve full recovery. All reasonable effort should be made to accomplish conservation measures that enable a listed species to recover in the wild, with or without intervention (e.g., artificial captivity provisioning), **prior to** implementing controlled propagation for reintroduction or supplementation." [emphasis is by author]

Another reason for this reluctance to advance a controlled propagation program is to avoid risks associated with hatchery products: 1) avoid reducing genetic variability within naturally occurring populations; 2) an increased level of inbreeding that would likely result from the enhancement of only a portion of the gene pool; and 3) diminishing a listed species' natural capacity to survive and reproduce in the wild through exposure to selection regimes in controlled environments. Identifying a critical number of individuals in the wild that would require a listed species to be brought into captivity or prepared for controlled propagation depends on species-specific demographic and environmental factors, and would have to be established on an individual basis.

## RECOMMENDATIONS

1. At this time, bringing humpback chub into captivity or developing a controlled propagation program does not appear prudent. With 2–3 wild core populations available for redundancy as insurance in case of a catastophic event, emphasis and resources should be placed on removing or minimizing threats to the species. Establishing a refuge or a captive propagation program for humpback chub could result in reduced numbers of recruits or adults in the wild, reducing genetic variability; enhancing only a portion of the gene pool; and developing selection regimes in controlled environments.

2. Existing genetic characteristics and variability of humpback chub are currently unknown, but are being investigated at Colorado State University. These studies should continue in order to assess the genetic status of the humpback chub. The existing genetic effective population size ($N_e$) should be determined for the species and for individual populations,

if possible, and compared with historic $N_e$. This metric may be evaluated as a means to determine critical population size for taking fish into captivity into a refuge or for captive propagation.

*Alternatives for the populations of Humpback Chub in the Upper Colorado River Basin (in priority)*

3. Continue to address threats to the species and translocate young-of-the-year (yoy; when available) from nearest populations to river reaches where threats have been reduced or minimized. For example, the Yampa Canyon population might be supplemented with Desolation/Gray yoy once the control of nonnatives is affected in Yampa Canyon. Suggest the movement of no less than 100 yoy per year for at least 5 years.

4. Move yoy to a refuge, i.e., a hatchery such as Ouray or Grand Valley, and expect to add yoy on an annual basis to minimize any genetic changes caused by genetic drift or adaptations to hatchery conditions. In addition, funding will be required to provide operation and maintenance of the fish held at the refuge. Identifying refuge, getting permits lined up for signature, and other associated logistics of getting fish out of the wild could be in place in case this is deemed necessary.

5. If a precipitous decline in all populations occurs and is validated[1], then breeding matrices (e.g., 25x25 paired matings) should be developed that utilize many individuals from the five diverse populations throughout the Upper Colorado River Basin, with the goal to maintain genetic variation of the original wild populations.

6. Augmentation of the populations should not occur until the threats have been removed or minimized to a level that reintroduced individuals can survive, mature, reproduce, and their progeny do the same.

*Alternatives for the Grand Canyon Population of Humpback Chub (in priority)*

3. Continue to address threats to the species and translocate yoy (when available), that would presumably be lost to the mainstem Colorado River, into tributaries where threats have been reduced or minimized. This strategy of translocation has been preliminarily successful in expanding the population in the Little Colorado River in an upstream direction, past a natural fish barrier, Chute Falls (personal communication, Pam Sponholtz, U.S. Fish and Wildlife Service). Suggest the movement of no less than 100 yoy per year for at least 5 years. Continue to explore other tributaries that may be suitable for translocations.

4. Move yoy to a refuge, i.e., a hatchery such as Willow Beach or Wahweap, and expect to add yoy on an annual basis to minimize any genetic changes caused by genetic drift or adaptations to hatchery conditions. In addition, funding will be required to provide operation and maintenance of fish held at the refuge. Identifying refuge, getting permits

lined up for signature, and other associated logistics of getting fish out of the wild could be in place in case this is identified.

5. If a precipitous decline in the population occurs and is validated[1], then breeding matrices (e.g., 25x25 paired matings) should be developed that utilize many individuals from diverse congregations throughout the mainstem Colorado River and Little Colorado River, with the goal to maintain genetic variation of the original wild population.

6. Augmentation of the population should not occur until the threats have been removed or minimized to a level that reintroduced individuals can survive, mature, reproduce, and their progeny do the same.

[1] The threshold that would require captivity should be determined by Recovery Team participants.

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