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MEMORANDUM

To: GCDAMP Technical Work Group

From: USGS/SBSC/GCMRC

M.E. Andersen, Biology Program Manager

Subject: Preliminary data regarding young humpback chub in Marble Canyon

Two important questions of interest to Grand Canyon natural resource managers and stakeholders are: 1) Do humpback chub spawn in the mainstem Colorado River in Grand Canyon? and 2) If humpback chub spawn in the mainstem, can they survive and over-winter in the mainstem? Because young humpback chub have limited swimming capability, it is reasonable to assume that young humpback chub captured well upstream of the Little Colorado River were spawned upstream. Further, if a cohort of humpback chub could be tracked and repeatedly captured at sites upstream of the Little Colorado River, it is reasonable to assume that these fish over-wintered and survived in the mainstem. The following are preliminary data, still subject to additional analysis and subsequent peer review, but they suggest that a small number of humpback chub have both spawned in the mainstem and that some of the offspring have successfully over-wintered there. We are sharing these preliminary data with you at this time because they may have important implications for the current monitoring and research program and for the development of the Long Term Experimental Plan.

Table 1 provides a summary of the young humpback chub captured in 2005 and 2006 in Marble Canyon between river miles 30 and 57. The data were collected by GCDAMP cooperators SWCA, AZGFD, USFWS, and GCMRC during the annual fall backwater seining project. During these years, mainstem water temperatures were the warmest observed since the 1970s. This reach of the Colorado River is immediately upstream of the reach where large numbers of rainbow trout and other nonnative fishes were removed between 2003 and 2006.

Table 1. Young humpback chub (HBC) captured between river miles 30 and 57 for years shown.

Year	# HBC captured	Mean total length	# samples
2005	193	36 mm	46
2006	154	34 mm	79
Total	347		

An examination of the length frequency data for these fish (Figure 1) suggests that the largest of these fish may have survived in Marble Canyon over the winter of 2005-06.

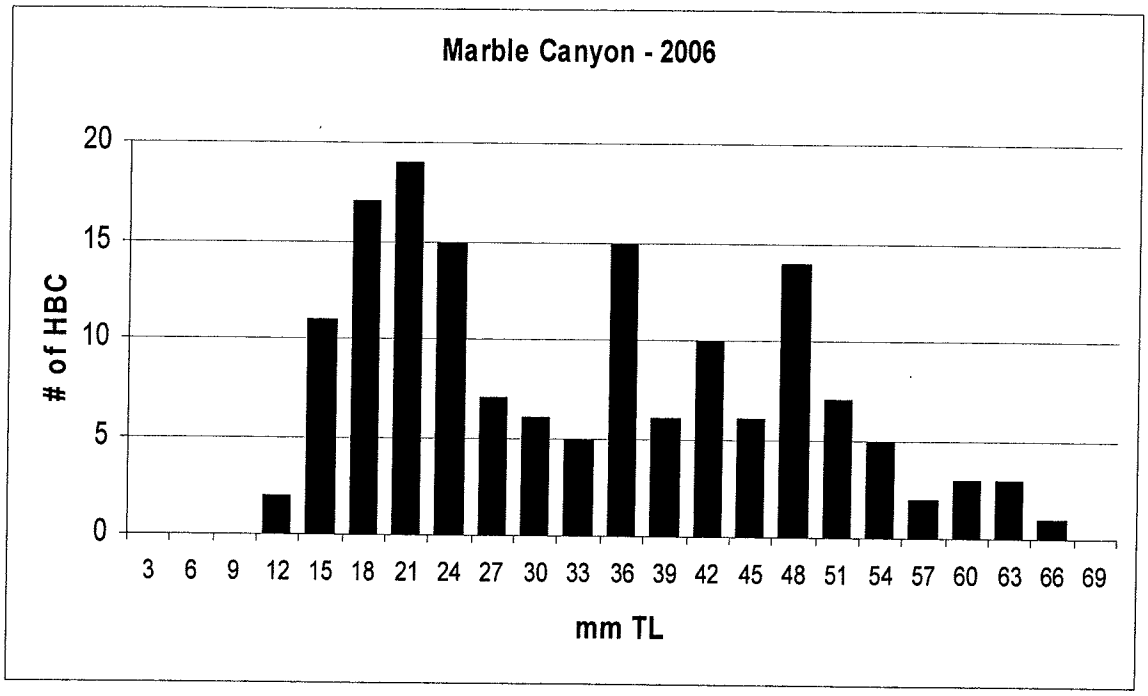

Figure 1. Length frequency of humpback chub captured between river miles 30 and 57 in 2006.

A peer-reviewed model (Petersen and Paukert 2005) was used to test this hypothesis. The model was used to estimate growth rates for humpback chub residing in the mainstem at river mile 30 with a water temperature of 12 °C. Initial runs of this model suggest that the mainstem water temperatures, though warmer in 2005 than the preceding three decades, were still too cool to allow humpback chub to grow from larvae to more than 50 mm in just a single season, providing a preliminary indication that fish of this size and greater were spawned in 2005 and survived the winter of 2005-06. Slow growth of the 2006 cohort is also indicated by this size distribution and estimated growth rate. To more accurately evaluate the hypothesis that humpback chub have survived over the winter, cooperating scientists will be providing additional water temperature, food availability, and fish growth rate data to the model. Additional model runs should help accept or reject the hypothesis that humpback chub have been able to over-winter in the reach.

To further resolve whether these largest fish over-wintered, GCMRC proposes to test

whether tissues from young humpback chub, especially the otolith, or inner ear bone, can be used to age these fish. This method has been used successfully to age rainbow trout in Glen Canyon and a number of fish species in North America. Several humpback chub were sacrificed as part of the Arizona Game and Fish Department's parasite monitoring trip, and otoliths from these fish may be available to test whether these bones are as useful for aging humpback chub as for other fishes. If humpback chub otoliths show promise for aging young individuals of this species, GCMRC will propose that additional small samples be taken, though requiring sacrifice of individuals, to allow for direct evaluation of the over-wintering hypothesis suggested by the currently available data.

In summary, preliminary data suggest that humpback chub may be able to spawn in the mainstem Colorado River, specifically in the reach beginning at river mile 30. Though mainstem temperatures remain colder than they were historically, they may have been sufficient to allow a small cohort of humpback chub to survive the winter of 2005-06 into the fall of 2006. The hypothesis that humpback chub have spawned and survived longer than 1 year in the mainstem Colorado River can be further tested with additional runs of a bioenergetic model and with analysis of tissues from young humpback chub captured in Marble Canyon. The model runs will be conducted by GCMRC and cooperators; samples for testing otolith aging will be sought. If the aging by otolith method shows promise, permission to sacrifice additional young humpback chub from this reach will also be sought. The GCDAMP fall seining project that has been collecting these data for the past few years will continue to be a high priority for GCMRC, sampling all backwaters in Marble Canyon, allowing for a comparison of 2007 data with those shown above.

Literature Cited

Petersen, J.H. and Paukert, C.P. 2005. Development of a bioenergetics model for humpback chub and evaluation of water temperature changes in the Grand Canyon, Colorado River. Transactions of the American Fisheries Society 134: 960-974.