June 30, 2004

The Honorable Secretary Gale Norton
Department of the Interior
1849 C Street NW
Washington, D.C. 20240

Re: MINORITY REPORT ON CONCURRENT POPULATION ESTIMATES OF HUMPBACK CHUB IN GRAND CANYON

Dear Secretary Norton,

The purpose of this minority report is to ask you to reconsider the Adaptive Management Work Group's (AMWG) recommendation that concurrent estimates of the humpback chub population in the Little Colorado River and the area of its confluence with the Colorado River be conducted. It appears that this recommendation rejects valid science (confirmed by the AMWG's independent review panel) in favor of externally and politically driven reasons. **The undersigned AMWG members believe that this recommendation contradicts best available science and is problematic for several other reasons, described below.**

Introduction

At the March 2004 Adaptive Management Work Group (AMWG) meeting, the AMWG received and considered a report AMWG had itself commissioned—*"An Independent Review of Ongoing and Proposed Scientific Methods to Assess the Status and Trends of the Grand Canyon Population of the Humpback Chub (Gila cypha),"* prepared by a panel of experts in the field of fish population estimation. This panel was convened by AMP Science Advisor James Kitchell. At the same March meeting, AMWG also received a letter to Michael Gabaldon from Duane Shroufe, Director of the Arizona Game and Fish Department, and Ralph Morgenweck and Dale Hall, Regional Directors of Region 6 and Region 2, respectively, of the U.S. Fish and Wildlife Service.

A motion was made to reprogram a budget item entitled "Implement HBC Expert Review Panel Recommendations" (referenced in above paragraph). The motion read, "To accept reprogramming of Line 91 to allow for concurrent multi-pass mainstream, mainstem and mark-recapture and Little Colorado River estimates in the spring." What this motion does essentially is shift $250,000 of funds in the current year and $200,000 in FY 2005 from implementing the recommendations of the expert panel to conducting increased sampling of humpback chub in the spring, including multiple sampling trips running concurrently in the mainstem and the Little Colorado River (LCR).

The motion was approved 19 – 4. Our organizations strenuously objected to this change for a number of reasons. We are providing this minority report so that you are fully

informed as to the arguments *against* the actions recommended to you by the majority of AMWG, and can consider them when making your decision.

Reasons to Reject AMWG Recommendation

Contradicts independent science. First of all, the AMWG-sponsored $50,000 independent science report concluded, contrary to the March AMWG recommendation, that the methodology currently used in Grand Canyon offers the "best available science." The report state that, "Upper Basin methods should not replace those currently employed in the Grand Canyon."

Further, Jeff Lovich, Chief of GCMRC, stated in his May 17, 2004 memo to Michael Gabaldon that the independent science report did not support doing concurrent population estimates:

> Despite clear recommendations from GCMRC management and researchers that concurrent sampling was not supported by an assessment of existing data, resolution for this problem was sought through convening and subsequent reporting of an independent review panel under the auspices of the Science Advisors for the GCDAMP. The report issued by that panel of experts in December of 2003 recommended a continuation and refinement of methods previously employed by GCMRC, as well as efforts to achieve more integration of methods employed in the Upper Basin and Grand Canyon over time. *The report did not recommend doing concurrent estimates.* [emphasis added]

Chief Lovich concluded against the AMWG recommendation by emphasizing that following the recommendation could undermine the scientific integrity of the Adaptive Management Program:

> It is GCMRC's position that the science and subsequent independent peer review do not support this decision. Implementation of the AMWG decision could undermine the scientific integrity of the Glen Canyon Dam Adaptive Management Program by ignoring the methodological rigor by which this position was established.

Increased handling of humpback chub. Another reason against the concurrent sampling regime recommended by the majority of the AMWG is that the additional handling of humpback chub inherent in the recommended sampling would have significant negative impacts on the already much-reduced humpback chub population. The Hopi Tribe is already concerned that fish handling may be a contributing factor in the declining population trend.

Increased costs to AMP. Another flaw inherent in the recommendation is the financial stress it would cause to the Adaptive Management Program. This recommendation will ultimately involve costs to the program estimated at $400,000 to $500,000 per year. This

money would be better spent implementing the independent panel's recommendations and supporting other pressing research and monitoring issues in the program.

AMP is not a recovery program. The Adaptive Management Program is not a recovery program, and therefore as long as our methods move us toward meeting our goal for attaining viable populations of humpback chub and removing jeopardy for them, we are not required to use program resources for the recovery goal purposes of establishing a baseline for downlisting or delisting humpback chub in Grand Canyon. Again, an independent panel of scientific experts has confirmed that our methods are appropriate for meeting our goals.

Degradation of cultural sites. The concurrent sampling recommended by AMWG would require additional time spent by researches in the Little Colorado River basin. For cultural reasons, the Hopi Tribe cannot support additional intrusions into the area when the current sampling methodology is sufficient to obtain information that meets AMP needs and the requirements of the independent review panel.

Letter from AZ Game & Fish and USFWS is flawed. The letter from Messrs. Shroufe, Morgenweck, and Hall, which was considered by the AMWG and may have influenced the vote of some AMWG members, is flawed in the following ways:

- The assertion contained within it relating to variability of estimates is misleading.
- It infers inaccuracy in population estimates due to the AMP's focus on the LCR, yet the AMP's modeling takes into account movement in and out of the LCR.
- It misinterprets the expert panel report to conclude that the Upper Basin approach is equally as valid as the AMP's approach, without recognizing the panel's geographical distinctions.
- It incorrectly assumes that Age-Structured Mark-Recapture (ASMR) estimates (currently used in Grand Canyon) need to be verified against Upper Basin methods in order to satisfy the requirements in the recovery goals.
- It incorrectly asserts that concurrent estimates would allow comparisons with previous population estimates.
- It incorrectly asserts that it is possible to validate one of the two methods (Upper Basin or ASMR) in a head-to-head comparison without knowing the real size of the population.

Provided below is additional information on our conclusions regarding the flaws in the Game & Fish/USFWS letter, followed by our recommendations.

Different approaches to population estimation. The letter notes that, "The approach to population estimation taken by the Adaptive Management Program (AMP) and the Grand Canyon Monitoring and Research Center (GCMRC) differs from the approach identified in the Recovery Goals." The letter also notes that

this is an "innovative strategy" but that their conundrum is how to resolve whether it is an acceptable approach for meeting the criteria in the recovery goals.

It appears to us that the ASMR model is an excellent solution to the unique conditions in Grand Canyon. It seems to provide robust abundance, trend and recruitment information that is required in the Adaptive Management Program's strategic plan while minimizing potential impacts to chub from repeated capture and handling. In addition, it has been subject to the review by an independent science panel (Kitchell et al. 2003) and found to represent "the best available science." We join the authors of the letter in applauding GCMRC for their innovative strategy.

Although we appreciate the conundrum facing the Service, we must also point out our conundrum of not being a recovery program and having many members adamantly opposed to spending our limited funding on recovery activities. Furthermore, we would like to point out that although the recovery goals did indeed recommend closed-population estimators over direct enumeration and removal estimates, no analysis was provided in the document to compare the efficiency and effectiveness of open and closed population models for these populations nor was any justification provided to reject the utility of open-population models, especially in the unique case of Grand Canyon.

Variability of models. The letter states, "...humpback chub population estimates for the Grand Canyon have been highly variable." We assume that the authors are concerned that the different estimators in the ASMR model (formulation 1 and formulation 2) make different assumptions and thus produce different point estimates. Results of the abundance estimates for Grand Canyon between 1989 to 2002 were presented at the fall 2003 science symposium (Coggins and Walters 2003). Interpolating numbers from the graph of age 4+ abundance, formulation 1 estimates that humpback have declined from about 11,500 in 1989 to about 3500 in 2002. In contrast, formulation 2 estimates that humpback have declined from about 10,500 in 1989 to about 4500 in 2002. Rather than being variable, the confidence intervals on these estimates are very tight. The 'variability' in abundance comes from not knowing which formulation is the best representation of the true abundance.

We'd like to point out that the 'variability' due to different estimators is not endemic to open-population models. The independent panel (Kitchell et al. 2003) noted that the estimate of abundance provided by closed-population models (e.g., Program CAPTURE) can exhibit "poor precision and vary considerably among models." The independent panel also discusses the problem of choosing the most appropriate model when several may be almost equally supported by the data. Studies in the Upper Basin[1] as well as Grand Canyon[2] demonstrate the difficulties in deciding on the most appropriate estimator.

GCMRC focus on LCR and geographical closure. The letter states, "Most of the estimates were focused on the Little Colorado River which may account for a portion of the populations." Although sampling is mainly confined to the LCR, this makes sense in that successful spawning is virtually confined to the LCR and stress from capture and handling is arguably lower in the LCR than the mainstem. There are issues regarding the potential effect of movement patterns in and out of the LCR on the abundance estimate, but these issues can be resolved using other methods and have been addressed by GCMRC and the expert panel (Kitchell et al. 2003).

The letter also states, "Fish in the Grand Canyon population move extensively between the Little Colorado River and the mainstem Colorado River, hence the Recovery Goals' requirement of geographic closure for a closed-population estimator may not have been met." Long distance migration by humpback in Grand Canyon is well documented, and geographic closure cannot be assumed for humpback in the LCR. However, this movement is one of the reasons why open-population models (e.g., ASMR) are appropriate in this situation. To assume geographic closure in Grand Canyon, a huge area would need to be sampled—presumably this would include the LCR, the 'LCR inflow,' the 'Lava to Hance' aggregation, and perhaps even further downstream.

We'd like to point out that the lack of geographic closure is not endemic to Grand Canyon. Violations of this assumption has been documented at Black Rocks and Westwater Canyon, and the researchers recommend exploring alternative models, including open-population models (McAda 2002, Hudson and Jackson 2003). Geographic closure may also be violated in the Yampa Canyon population, and the researchers recommend expanding the geographic area into the Green River in Dinosaur National Monument (Haines and Moode 2002). The lack of geographic closure in all four populations that have been studied to date (reports are not yet available from either Desolation/Gray or Cataract Canyon) suggests that the recommendation for using closed-population models is unfounded.

Independent Expert Panel. The letter states that the independent scientific panel convened by AMWG "found '*...little merit in changing the sampling practices...*' for those populations, bearing out the value of both approaches." We do not believe that the author's assertion is warranted and would like to clarify that the independent expert panel made the following conclusions and recommendations:

1. "The analytical methods currently employed in the Upper Basin are appropriate *pro tem*, but could be improved as more data become available. The Panel encourages development of open population methods as the database improves...."
2. "The panel finds little merit in changing current sampling practices. Sampling should occur when the greatest number of fish can be captured with the least harm to the fish—i.e., spring in the Grand Canyon and fall in the Upper Basin."

3. "The ASMR model proposed and applied by Walters and Coggins (2003b) is an appropriate way to deal with the biases introduced by heterogeneity in catchability related to age. It is based on the existing and proven methodology of Pollock (1981) and offers 'best available science' as the source of evidence regarding the status and trends of humpback chub in the Grand Canyon ecosystem." The panel goes on to make recommendations to improve the estimates from ASMR—none of which suggest a need to validate the model with closed-population estimates.

The expert panel is clear that the closed-population models used in the Upper Basin populations are of value for Upper Basin populations for the time being, but state that, "As more data becomes available in the Upper Basin studies, more complex models such as the ASMR can be applied." The panel is equally clear that "...ASMR is most appropriate for the Grand Canyon..." and "Upper Basin methods should not replace those currently employed in the Grand Canyon."

Need for comparison between ASMR and closed-population models. The letter notes that the open-population model used in Grand Canyon "may prove to be fully adequate for tracking the demographic requirements of the recovery goals." However, the letter argues a need to "...verify the information generated by those models against the estimates generated by the methods advocated in the Recovery Goals, and to determine as accurately and precisely as possible the number of adult humpback chub constituting the Grand Canyon population."

It is unclear to us why this comparison is needed. The ASMR model estimates the current abundance of humpback somewhere between 3500 adults (formulation 1) and 4500 adults (formulation 2). Regardless of which formulation most accurately represents abundance, it is clearly above the MVP of 2100 adults derived in the humpback chub recovery goals. Furthermore, the two formulations are similar in their depiction of how much the population has declined between 1989 and 2002, a declining trend that clearly does not meet the recovery goals criteria for no net loss. From our perspective, the ASMR model in Grand Canyon not only meets the needs of the Adaptive Management Program, but as the "best available science," it also meets the needs of the Recovery Program.

Comparison with closed-population estimates in the early 1990s. The letter suggests that a concurrent estimate would allow a comparison with the population estimates in the early 1990s. Presumably the authors are alluding to the studies by (Douglas and Marsh 1996) and (Valdez and Ryel 1995), and if so, it is unclear how a comparison would be made. (Valdez and Ryel 1995) estimated the number of adult humpback (>200 mm) for six mainstem aggregations while (Douglas and Marsh 1996) estimated the abundance of both adult and subadult humpback (i.e., fish >150 mm) the LCR. Because these studies were undoubtedly counting some of the same fish, because of the difference in size class estimated, and because the point estimates and confidence intervals were calculated separately, it's uncertain how a comparison to a contemporary estimate could possibly be made.

However, if a valid method to combine the results from the two earlier studies could be developed, it is still not clear that there would be sufficient statistical power to detect a population trend if one did in fact exist. The data from Westwater Canyon illustrate the difficulty. The population estimate at Westwater Canyon dropped by over half between 1998 and 2000 (4744 adults to 2201 adults), but amazingly, this decline was not statistically significant because of large confidence intervals around the estimates and small p-value needed to establish statistical significance. To address this issue, the expert panel encourages "some **rigorous assessment of the statistical power** of proposed sampling designs and protocols to detect meaningful departures from a stable growth rate [emphasis theirs]."

Validation. The letter states, "Estimates from the two approaches could be directly compared to validate either or both, based on validation criteria that we would jointly agree to prior to the field effort." We do not believe it will be possible to validate either the open-population or the closed-population models in a head-to-head comparison unless you also know the size of the real population. In addition, the expert panel considered the value of concurrent LCR and mainstem sampling and rejected it in favor of alternative methods because of high cost, and potential impacts (capture stress and handling mortality) to humpback from sampling in the mainstem.

Given that the proposed validation effort would be done for the purposes of meeting the recovery goals, we believe that any comparison needs to consider how the various models and methods perform on the full suite of demographic criteria in the recovery goals. In addition to abundance, the goals require that: 1) the trend in adult point estimates does not decline significantly; and 2) that mean estimated recruitment of age-3 naturally produced fish equals or exceed mean annual adult mortality. As previously mentioned, the statistical power to detect population trends using the methodology in the Upper Basin is very low. Because closed-population models do not estimate recruitment, it is not known how this parameter will be estimated in populations that use closed-population models, or how the selected alternative will compare with estimates of recruitment produced with the ASMR model.

Conclusion

We believe that the ASMR model provides robust estimates of abundance, trend and recruitment while minimizing impacts to humpback chub from capture and handling. It appears to us that:

- The ASMR methodology not only meets the needs of the Adaptive Management Program, but of the Recovery Program as well.
- We should follow the recommendations made by the expert panel convened and paid for by AMWG—including those recommendations for simulating the

bias and precision of closed-population models and those for improving ASMR.

- The incremental improvement in our understanding of the population demography in Grand Canyon from the proposed closed-population estimate comes at a tremendous cost and may result in unacceptable impacts to an already imperiled population of chub. The funds would be better spent on the projects for which they were originally earmarked.

RECOMMENDATION

We believe that this is a significant issue for you, and we recommend that you seek additional information from your agencies to flesh out this issue before accepting the majority recommendation of the AMWG.

Specifically, we recommend that you request that: 1) GCMRC provide you with a comprehensive cost-benefit analysis of using different models for abundance, trend, and recruitment; 2) the USFWS provide you with an analysis of the incidental take expected from the additional sampling; and 3) the entities responsible for permitting provide you with their analysis of the need and impact of the proposed action.

The recommendation that you have received on this issue is not the result of consensus, and we believe that it was based in part on flawed information rather than the best available science.

We look forward to the Secretary's response.

Sincerely,

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Endnotes

[1] The abundance of humpback at Black Rocks ranged from 764 (512-1206) in 1998, to 921 (723-1208) in 1999, to 539 (223-1497) in 2000 when using the M_o estimator selected by program CAPTURE (McAda 2002). However, McAda notes, "Population estimates were highly variable depending on the model selected to make the estimate." For example, population estimates in 1998 ranged from 343 (311-383) using the Jackknife M_h estimator to 1,446 (841-2603) using Chao M_h estimator even though the model selection criteria for both of these estimators were only slightly different (0.88) than that for M_o (0.92).

Large variability in abundance resulting from estimator selection is also evident for the 1998 to 2000 data at Westwater Canyon. (Hudson and Jackson 2003) write, "The model selection function of Program CAPTURE resulted in variability among years in determination of the most appropriate estimator...." For these data, the M_o estimator was ranked the highest in 1998 and 2000 by the program's selection function, but there was no appropriate estimator for the 1999 data. Using the M_o estimator, the estimated abundance of humpback declined from 4744 (3085-7462) in 1998, to 2215 (1322-3863) in 1999, to 2201 (1308-3855) in 2000. However, the selection criteria for Jackknife M_h was not much lower than the criteria for M_o, but would have produced a very different picture of the Westwater population. The Jackknife M_h model estimated a decline from 958 (902-1022), to 525 (484-573), to 509 (469-556).

[2] Closed-population estimates have been made in Grand Canyon during 1991-1993 for six of the mainstem aggregations (Valdez and Ryel 1995). They determined that the selection routine did not perform well when capture probabilities are low and after reviewing the strengths of each estimator, they judged the Chao M_h and M_t to be the most reliable. Even so, the difference between these two estimators for the LCR Inflow aggregation differed by several hundred adults in each of the three years.

Closed-population estimates have been made in Grand Canyon during 1991-1992 for the LCR (Douglas and Marsh 1996). The five best estimators reported ranged from 4508 adults using the M_{bh} estimator to 10,444 adults using M_h.