United States Department of the Interior
Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
(602) 640-2720 Fax (602) 640-2730

In Reply Refer To:

AESO/SE
2-21-93-F-167

April 3, 1997

MEMORANDUM

TO: Regional Director, Bureau of Reclamation, Salt Lake City, Utah (Attn: C. Karas)

FROM: Field Supervisor

SUBJECT: Review of Sufficient Progress in Implementation of the Elements of the Reasonable and Prudent Alternative from the December 21, 1994, Biological Opinion on the Operations of Glen Canyon Dam

This is in response to your November 27, 1996, and subsequent March 13, 1997, letters to the Fish and Wildlife Service which concluded that the Bureau of Reclamation has made sufficient progress on the implementation of the December 1994 Biological Opinion. Your November 27 letter also asked for our written view of this conclusion. The Biological Opinion requested an annual meeting to coordinate reasonable and prudent alternative activities. One of the goals of the meetings was to provide the Service an opportunity to determine whether sufficient progress is being made in accomplishing activities set forth to remove jeopardy to the listed species impacted by the operation of Glen Canyon Dam. An evaluation of sufficient progress is difficult to measure and subjective without established milestones or a schedule. Although varying amounts of progress towards completion of the elements of the reasonable and prudent alternatives have occurred, the Service is pleased with the direction of the implementation. We address each element of the reasonable and prudent alternative as described in your letter. We respectfully offer the descriptions of lack of sufficient progress in certain elements as a means to re-focus activities for the next year.

1- Adaptive Management Program

The Record of Decision on the Glen Canyon Dam Environmental Impact Statement was signed on October 9, 1996. The signing of the ROD formally adopted the preferred alternative including the Adaptive Management Program. The Adaptive Management Plan includes an Adaptive Management Work Group to facilitate the AMP. The Charter which establishes a Federal Advisory Committee for the Adaptive Management Work Group was signed by the Secretary of the Interior on January 15, 1997. These time consuming steps were necessary procedures for the implementation of the Adaptive Management Program. The Service is pleased that the process is continuing and looks forward to participation in the Adaptive Management Work Group.

1A - A Program of Experimental Flows

Your November 27 letter correctly states that the Reasonable and Prudent Alternative recommended experimental flows to include high steady flows in the spring, which may include habitat building and habitat maintenance flows. The December 1994 Biological Opinion called for a program of experimental flows to include high steady flows in the spring and low steady flows in summer and fall.

The purpose of the beach/habitat building flow as described in the Final Environmental Assessment and Finding of No Significant Impact include "...rebuilding eroded sandbars, reforming backwater habitats for native fish and mimicking the natural processes that create a dynamic Grand Canyon ecosystem." Further it states "This test is needed to scientifically verify the predictions stated in the final EIS on Glen Canyon Dam operations. That is, to test the hypothesis that the dynamic nature of fluvial landforms and aquatic and terrestrial habitats can be restored by short-duration releases substantially greater than powerplant capacity." Although the Service supported the beach/habitat maintenance flow as a means of reforming backwater channel habitats which could be used by native fishes, the dismissal of the low steady flows in summer and fall indicates only partial progress toward meeting the intent of this element of the RPA. Your November 27 letter concludes the same (Page 2, first paragraph) referring to the delays associated with the signing of the Record of Decision, which as stated earlier, implemented the Adaptive Management Program and would coordinate experimental flows.

Since the ROD had not been signed before the time designated to conduct the beach/habitat building flow, a separate Environmental Assessment and section 7 pursuant to the Endangered Species Act were conducted. The Service believes that low steady flows in the summer and fall could have been included with the beach/habitat building flow or undergone separate environmental compliance. At a minimum, low steady flows could have been designed for possible implementation following the high flows.

The December 1994 Biological Opinion stated that design of the experimental flows was to begin as soon as possible and be completed by October 1996. The Biological Opinion stated that "Unless the Service determines information provided seriously questions the validity of experimental designs developed or contribution of the resulting data to remove jeopardy to the federally-listed aquatic fauna of the Grand Canyon, experimental flows will be initiated in April 1997." The Service is not aware of progress towards designing a program of experimental flows which will include high steady flows in the spring and low steady flows in the summer and fall. Your November 27 letter states that the Grand Canyon Research and Monitoring Center has conducted multiple meetings to formulate research needs.

The December 1994 Biological Opinion also states that "If sufficient progress and good faith effort is occurring towards initiating experimental flows, implementation of experimental flows may occur later in 1997." Your November 27 letter states that due to high water releases predicted for Glen Canyon Dam, implementation of the preferred alternative is to be implemented over the experimental flows. As high water releases are also expected for the next

year or two, experimental flows must be delayed until suitable water conditions are met. This delay may provide an excellent opportunity to design the experimental flows.

There have been no efforts to develop/design experimental low steady flows by Reclamation or the Grand Canyon Monitoring and Research Center. However, we understand that the SWCA Integration Workshop held on February 27 and 28 discussed the issue. It is our understanding that the researchers expressed a consensus that experimental steady low flows were needed to better understand the potential for edge/backwater warming, system productivity, response of non-native fish, and to assess the relative effect of warmed water from a multi-level intake structure.

We believe further discussion should occur between our two agencies on when the experimental flows might occur. Although the ROD states that beach/habitat building flows will occur during high water years, the Service believes this does not preclude any experimental high steady flows in the spring and low steady flows in the summer and fall. The Service's Biological Opinion requested that these experimental flows occur during low water years because the beach/habitat building flows were scheduled for low water years during the Draft Environmental Impact Statement. Your November 27 letter states that the experimental flows are not occurring in 1997 because it is not a 8.23 million acre feet water year. If Reclamation intends to implement the experimental flows as stated in the Biological Opinion, the Service believes that Reclamation needs to commit to a minimum of conducting habitat maintenance flows (33,200 cfs) during a low water year.

1B - Selective Withdrawal Program for Lake Powell

Your November 27 letter states that a report will be completed in 1997. It would seem that a judgment on the progress of this element would best be deferred until we received the document. It is our understanding that a temperature control workshop was completed. An environmental assessment is scheduled to begin in FY 98, and Reclamation has assigned Dave Trueman to coordinate these activities. We are pleased with Reclamation's perseverance to this process and look forward to receiving the mentioned report.

1C - Determine responses of native fish to various temperature regimes and river flows (future research program)

Your November 27 letter states that contracts for certain fish studies have been renewed and that future research and long-term monitoring will be conducted through the Center. In order to fulfill this requirement, the Center should specifically outline the studies. If the research and long-term monitoring programs include evaluating temperature and flows similar to the program of experimental flows recommended in item 1A, the Service would agree that sufficient progress is being made.

2 - Protect humpback chub population and habitat in LCR by being instrumental in developing of a management plan.

Your November 27 letter states that a draft document will be submitted to the Service for comments. It would seem that a judgment on the progress of this element would best be deferred until we received the document.

3 - Sponsor razorback sucker workshop

The Service appreciates that the razorback workshop has been completed. One of the goals of the workshop was to develop a management plan for the species in Grand Canyon. Your November 27 letter states that the Service should now recommend a course of action and develop a Memorandum of Understanding. The Service questions if the recommendations that resulted from the workshop constitute a "management plan" which would facilitate the Service in developing a course of action. We would appreciate your interpretation of the whether the workshop results comprise a "management plan."

4 - Establish a second spawning population of humpback chub

Information collected on tributaries, backwater habitats, aquatic food base, and other aspects during Glen Canyon Studies and Interim Flow monitoring will be useful for this work item. Other than the collection of this baseline information, the Service does not believe significant progress has been made towards the implementation of this element of the Reasonable and Prudent alternative.

Other work related to endangered species

The biological assessment to evaluate the effects of the preferred alternative on the southwestern willow flycatcher was expected to be sent to the Service by the end of January. As of this date, we have not received that document. As a reminder, in the consultation between Reclamation and the Service on the beach/habitat building flows, the Service issued the following reasonable and prudent measures necessary to minimize take for the southwestern willow flycatcher. "Initiate formal consultation for the southwestern willow flycatcher on the preferred alternative to the FEIS before January 31, 1997, including in the biological assessment data from the test flow final reports due December 31, 1996."

The November 1994 Biological Opinion required that the Kanab ambersnail population and habitat be quantified. The opinion also required that the habitat in Grand Canyon be surveyed before and after any flow greater than 25,000 cubic feet per second (cfs). The Service is appreciative of the population and habitat evaluations completed by the interagency effort of the Glen Canyon Environmental Studies Office, Arizona Game and Fish Department, the Service and others. Our two agencies do not have a process for implementing the necessary habitat evaluations during flows greater than 25,000 cfs. In the past we have successfully relied on the readiness and availability of the GCES staff, and the ongoing monitoring associated with the

beach/habitat maintenance flows. Now that the beach/habitat maintenance flow monitoring is completed, and a 1997 and subsequent long term monitoring has not been finalized for this species, the Service is not clear on how this element will be completed.

The Service appreciates your continued coordination and assistance. If you have any questions or if we can be of further assistance, please contact Debra Bills or Ted Cordery.

Sam F. Spiller

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (GM:AZ)(AES)
Director, Arizona Game and Fish Department, Phoenix, AZ
Superintendent, Grand Canyon National Park, Grand Canyon, AZ
Chief, Biological Support Branch, Bureau of Reclamation, Salt Lake City, UT (Attn: UC 770)
Director, Biological Services Program Manager, Grand Canyon Research and Monitoring Center, Flagstaff, AZ
Project Coordinator, Arizona Fisheries Resources Office, Flagstaff, AZ

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In Reply Refer To:
AESO/SE
2-21-93-F-167

June 30, 1997

MEMORANDUM

TO: Regional Director, Bureau of Reclamation, Salt Lake City, Utah (Attn: Biological Support Branch)

FROM: BEING Field Supervisor

SUBJECT: Implementation of Reasonable and Prudent Measures of a Biological Opinion on the Operations of Glen Canyon Dam

This is to follow up on our April 3, 1997, memorandum to the Bureau of Reclamation which reviewed the progress of implementation of the elements of the reasonable and prudent alternative from the December 21, 1994, biological opinion on the operations of Glen Canyon Dam. In that letter, the Fish and Wildlife Service also discussed the pending consultation on the southwestern willow flycatcher.

In the consultation between Reclamation and the Service on the beach/habitat building flows, dated February 16, 1996, the Service issued the following reasonable and prudent measures necessary to minimize take for the southwestern willow flycatcher. "Initiate formal consultation for the southwestern willow flycatcher on the preferred alternative to the FEIS before January 31, 1997, including in the biological assessment data from the test flow final reports due December 31, 1996." As of this date, we have not received that document. Please notify this office at your earliest convenience to discuss the consultation schedule for this project.

The Service appreciates your continued coordination. If you have any questions or if we can be of further assistance, please contact Debra Bills or Ted Cordery.

for Sam F. Spiller

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (GM:AZ)(AES)
Director, Arizona Game and Fish Department, Phoenix, AZ
Superintendent, Grand Canyon National Park, Grand Canyon, AZ

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Sam F. Spiller

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (GM:AZ)(AES)
Director, Arizona Game and Fish Department, Phoenix, AZ
Superintendent, Grand Canyon National Park, Grand Canyon, AZ
Chief, Biological Support Branch, Bureau of Reclamation, Salt Lake City, UT (Attn: UC 770)
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In Reply Refer To:
AESO/SE
2-21-93-F-167

May 27, 1999

Memorandum

To: Regional Director, Bureau of Reclamation, Salt Lake City, Utah

From: ACTING Field Supervisor

Subject: Review of Sufficient Progress in Implementation of the Elements of the Reasonable and Prudent Alternative from the December 21, 1994, Biological Opinion on the Operations of Glen Canyon Dam

This is in response to your February 25, 1999, memorandum to the Fish and Wildlife Service which summarizes the Bureau of Reclamation's evaluation of the progress during 1998 in implementation of the subject December 1994 Biological Opinion to remove jeopardy to the humpback chub (*Gila cypha*) and razorback sucker (*Xyrauchen texanus*). In addition, Debra Bills and Don Metz of this office met with Tony Morton of your staff on April 1, to informally discuss the status of implementation.

As stated in your February 25 memorandum, this is Reclamation's third review of implementation progress. The first review initiated by Reclamation on November 27, 1996, was concluded with a memorandum from this office on April 3, 1997. The second request was initiated by Reclamation on December 12, 1997. The Service did not officially respond to that request but informally concluded that conditions were essentially the same in 1997 as they were in 1996. This memorandum serves as our official review of the status during 1998.

An evaluation of sufficient progress is difficult to measure and is subjective without established milestones or a schedule. Although we believe varying amounts of progress toward implementation of the elements of the reasonable and prudent alternatives have occurred, the Service acknowledges the demanding tasks and applauds the completed elements. We respectfully offer the descriptions of lack of progress as a means to re-focus activities for the subsequent years. The complete elements of the reasonable and prudent alternative are listed and discussed below.

Element 1.

Attainment of riverine conditions that support all life stages of endangered and native fish species is essential to the Colorado River ecosystem. Therefore, Reclamation shall develop an adaptive management program that will include implementation of studies required to determine impacts of flows on listed and native fish fauna, recommend actions to further their conservation,

and implement those recommendations as necessary to increase the likelihood of both survival and recovery of the listed species.

The Adaptive Management Program, an EIS common element, was still being formulated as we prepared th(e) biological opinion. The Service supports adaptive management as an iterative approach to resource management. We recognize that the aquatic and terrestrial ecosystems below Glen Canyon Dam are still adjusting to impacts from dam operations that will continue into the future. Thus, the need for adaptive management. Actions taken through this approach must be based on integrated resource approach, and, as discussed by Hilborn (1992) an active rather than a passive learning system that includes deliberative experimental design.

Status 1.

As stated in your February 25, 1999, memorandum, the Adaptive Management Work Group (AMWG) began meeting in September 1997. The Service joins Reclamation and the other stakeholders on the AMWG and the Technical Work Group (TWG). This task has been completed.

We encourage Reclamation to join the Service in continuing to advocate actions to the AMWG and TWG that will further species conservation, and implement those recommendations as necessary to increase the likelihood of both survival and recovery of the listed species. The Service is aware of the position of some members of the AMWG that commitments made between Reclamation and the Service tends to burden the adaptive management program. The final EIS states that the "The AMP... is not intended to derogate any agency's statutory responsibilities for managing certain resources." Further, "...all program activities would comply with applicable laws and permitting requirements." One of the goals of the AMP is to "Assur(e) resource management obligations are defined and fulfilled in good faith without abridgement of any Federal, State, Tribal, or other legal obligation." The Endangered Species Act requires all Federal agencies to use their authorities to not just reduce effects, but to conserve endangered and threatened species.

Element 1A.

A program of experimental flows will be carried out to include high steady flows in the spring and low steady flows in summer and fall during low water years to verify an effective flow regime and to quantify, to the extent possible, effects on endangered and native fish. Studies of high steady flows in the spring may include studies of habitat building and habitat maintenance flows. Research design and hypotheses to be tested will be based on a flow pattern that resembles the natural hydrograph, as described for those seasons in the SASF (seasonally adjusted steady flow).

Information from final GCES endangered fish reports, researchers who conducted those studies, and other knowledgeable individuals will be used to assist in determining an experimental flow regime of high spring flow and low summer and fall flow for endangered fishes and to develop

hypotheses and studies to accompany those flows with final review and approval by the Service. Reclamation will provide technical assistance and funding.

Design of the experimental flows and associated studies will begin as soon as possible and be targeted for completion by October 1996. Unless the Service determines information provided seriously questions the validity of experimental designs developed or contribution of the resulting data to remove jeopardy to the federally-listed aquatic fauna of the Grand Canyon, experimental flows will be initiated in April 1997. If sufficient progress and good faith effort are occurring toward initiating experimental flows, implementation of experimental flows may occur later in 1997. If the Service believes there is not sufficient progress, Glen Canyon Dam would be operated as SASF flows during spring through fall (April to October) beginning in 1998. If the Service determines a study design can not be developed that is expected to provided information to support removal of jeopardy to the razorback sucker and humpback chub populations in the Grand Canyon and associated tributaries, such will be considered new information and may be grounds for reinitiating formal consultation.

This element is based on low release years (8.23 maf) occurring approximately 50% of the time. Further improvement of the means for determining a low water year that would initiate the implementation of research flows in a given year will be developed by Reclamation with concurrence by the Service. This may include, for example, methods based on content of water in Lake Powell at a given date. When implemented, experimental flows will be conducted for a sufficient period of time to allow for experimental design, biological processes to function, and for variability inherent in riverine ecosystems to be expressed. The number of years to conduct the experimental flows is, therefore, indeterminate.

During moderate and high release years, Reclamation shall operate Glen Canyon Dam according to requirements of the MLFF. Operations during moderate and high water years would assist in achieving some of the variability that was always present in the historic Colorado River and under which the endangered and other native fish evolved.

Following analysis of the data, appropriate operational flows will be determined by the Service and implemented by Reclamation in compliance with section 7(a)(2), Endangered Species Act.

Status 1A.

This element has not seen sufficient progress. Other than the controlled BHBF in 1996, there have been minimum efforts to develop experimental flows for native fishes. The 1997 Fall Maintenance Flow and canceled 1998 BHBF were designed to protect sediment resources. Although there was some expectation that backwaters and other nearshore habitats could be rejuvenated by these flows, this was not the purpose of the flows. We understand that it is Reclamation's intent to coordinate this RPA through the Adaptive Management program and to develop flows that will include scientifically based peer reviewed criteria to measure and evaluate their impacts on downstream resources. We respect this intention and encourage the development of the criteria. We also encourage the same level of analysis for flows designed to

protect sediment resources. We understand that a contract to design a research and implementation plan for endangered fish research has been granted to SWCA in fiscal year 1999. The Service looks forward to the conclusions of this contract and will provide review and recommendations when requested.

Element 1B.

Reclamation shall implement a selective withdrawal program for Lake Powell waters and determine feasibility using the following guidelines.

i. Review historic information and employ existing modeling with possible updates using alternative reservoir and operating conditions to prepare a set of possible scenarios of temperature changes in the mainstem.

ii. Determine from the literature, experimentation, and consultation with the AGFD, Native American Tribes, National Park Service, Service, and other native fish species experts the anticipated effects on native fish populations which may result from implementation of temperature changes from a selective withdrawal structure. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval/juvenile growth and temperature.

iii. Assess the temperature induced interactions between native and non-native fish competitors and predators.

iv. Assess the effects of temperature, including seasonality and degree, on *Cladophora* and associated diatoms, *Gammarus*, aquatic insects, and fish parasites and disease.

v. Evaluate effects of withdrawing water on the heat budget of Lake Powell, effects of potentially warmer inflow into Lake Mead, and the concomitant effects on the biota within both reservoirs. Evaluate the temperature profiles along with heat budget for both reservoirs.

vi. Evaluate effects of reservoir withdrawal level on fine particulate organic matter and important plant nutrients to understand the relationship between withdrawal level and reservoir and downstream resources.

Installation of a selective withdrawal structure at Glen Canyon Dam may be essential in order to increase water temperatures downstream. Warmer mainstem temperatures are needed to ensure successful spawning and recruitment of endangered and native fishes in the mainstem. Research identified for this element should be integrated or combined with the research program specified in Element C. A selective withdrawal structure would provide considerable flexibility in managing the aquatic ecosystem downstream of Glen Canyon Dam. Management options, such as when to release warmer temperature water, seasonal patterns of releases to avoid establishment of permanent backwater areas, and use of floods, would all be available to limit expansion or invasion of non-native fish species.

The Service cautions the selective withdrawal structure should not be considered the only action needed to provide successful mainstem spawning and recruitment and ultimate recruitment for the humpback chub and razorback sucker. Aspects of the natural hydrograph, including low, steady releases in the summer, are considered necessary based on present knowledge of the temperature capabilities of a selective withdrawal structure and habitat requirements of the species. Future studies might identify opportunities to operate Glen Canyon Dam in a manner that would alleviate conditions that jeopardize the continued existence of listed fish in the Grand Canyon and minimize impacts on water utilization for power production and other purposes. This program also is one of the EIS common elements.

Status 1B.

The Service believes Reclamation has made great progress in developing a program for the selective withdrawal program. Many portions of the program are not yet developed including some of the research identified for this element which could be integrated or combined with the research program specified in Element C, below. Aspects of the natural hydrograph, including low, steady releases in the summer, must be tested with the temperature control devise to evaluate our present knowledge of the temperature capabilities of a selective withdrawal structure and habitat requirements of the native fish species. We encourage the determination and initiation of research needs that must be gathered before the temperature control device can be tested.

Element 1C.

Determine responses of native fishes in Grand Canyon to various temperature regimes and river flows of the experimental flows and other operations of Glen Canyon Dam. Studies will emphasize collection of information necessary to remove jeopardy to federally-listed species and identify actions necessary to enhance their recovery. Reclamation will provide technical assistance and funding for research to accomplish the following studies.

i. Determine the effects of water temperature on reproductive success, growth, and survivorship of Grand Canyon fishes.

ii. Determine relationships among tributary hydrology, reproductive success of fishes, and the abundance of fishes in mainstem rearing habitats.

iii. Determine the effects of mainstem hydrology on the number of nearshore rearing habitats, environmental conditions in these habitats, and their successful utilization by fishes.

iv. Assess biotic interactions between native and non-native fishes, particularly those that occur in nearshore rearing habitats affected by dam operations.

v. Determine humpback chub life history schedule for populations downstream of Glen Canyon Dam.

vi. Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources.

vii. Determine the effects of dam operations, including modifications to regulate water temperatures, on the parasites and disease organisms of endangered and native fishes in Grand Canyon.

Emphasis should be placed on experimental approaches using various flow and temperature scenarios to determine cause and effect relationships between dam operations and responses of the community of endangered and native fishes endemic to the Grand Canyon. Efforts should be hypotheses driven and specific in objectives. Explanation of the above research efforts is provided in Appendix 1 (not included here) along with suggested hypotheses. The success of these research efforts will require sufficient flexibility in operations to design and carry out the experiments. Wherever feasible, off-site experiments should be considered as a means of generating or supporting the testing of hypotheses to reduce on-site study time and complexity. Long-term measurements should more appropriately be incorporated into the monitoring program, but there must be an active synergism between the two efforts.

The long-term monitoring plan should define objectives and methods for tracking the status of native fishes in Grand Canyon. Relevant indices should be developed and measured in support of the long-term monitoring plan. A major advantage of the current intensive marking studies using passive integrated transponder tags is the ability to measure future movements, growth rates, and population sizes of these fishes. This legacy, and others made available by this period of intensive research effort, should be effectively incorporated into the long-term monitoring program for fishes. Adaptive management, an EIS common element, would likely include a number of the above research objectives.

Status 1C.

As stated in your February 25, 1999, memorandum to this office, contracts for certain fish studies have been renewed to preserve a long-term data base. In addition, reports generated from the March/April 1996 experimental beach habitat building flow provided useful information on the response to the aquatic community. Yet, significant information needs and data gaps exist. As stated in your February 25 memorandum, the 1997 "Aquatic Ecosystem of the Colorado River in Grand Canyon - Grand Canyon Data Integration Project Synthesis Report" by SWCA (Integration Report) lists eleven significant data gaps listed below, many of the same concepts listed in this element of the RPA.

1. A temperature model that will predict longitudinal downstream warming of the mainstem, as well as warming of shoreline and backwater habitats.
2. Bathymetry and temperature isopleths for inflows of the Paria River, LCR, Shinumo Creek, Bright Angel Creek, and Kanab Creek to determine the extent of ponding and thermal warming at various flows.

3. Primary and secondary productivity rates and levels for different flows longitudinally down the mainstem, in backwaters, and along shorelines.
4. Factors that limit survival of young humpback chub in the mainstem and recruitment to adulthood.
5. Biotic interactions of native/non-native fishes.
6. Rates of algal and macroinvertebrate drift for various flows.
7. Incidence and rates of infection by fish parasites, Lernaea cyprinacea and Asian tapeworm, as well as risk of increased infection associated with warming mainstem and shoreline habitats.
8. Timing and degree of drift by native larval fishes at tributary inflows, including the Paria River, LCR, Bright Angel Creek, Shinumo Creek, and Kanab Creek.
9. Flows for maintenance of the 30-mile aggregation of humpback chub, as well as the genetic significance of the fish as possible relicts of historic mainstem stocks.
10. Relationship of mainstem flows to nearshore habitats and channel geomorphology.
11. A complete Grand Canyon Aquatic Resources Database that is accessible to researchers and interested parties.

The Service understands that implementation of the RPA is expected to take several years. Reclamation has committed to completing the RPA, not the eleven data gaps from the Integration Report listed above. However, one of Reclamation goals in granting this contract was to address two questions.

1. Do sufficient baseline data exist to evaluate the influence of the steady flow experiment described in the RPA?
2. Do existing data indicate that the steady flow experiment will likely have an overall positive influence on endangered and other native fishes in Grand Canyon?

The conclusions in the Integration Report, which we believe Reclamation will rely on at least in part to decide whether to pursue a steady flow experiment that will benefit native fishes, is that sufficient baseline data to fully evaluate the steady flow experiment do not currently exist. Completion of the element of the RPA would have avoided the reiteration of these research needs in the SWCA Integration Report. If Reclamation believes these data gaps must be fulfilled before conducting steady flows for native fish, collection of information for these data gaps should be collected as soon as possible. Additional research questions will likely develop as hypotheses testing and long-term monitoring data become available. It is unfortunate, however, that there has not been an opportunity to conduct experimental approaches using various flow and temperature scenarios to determine cause and effect relationships between dam operations and responses of the community of endangered and native fishes endemic to the Grand Canyon.

Element 2.

Protect humpback chub spawning population and habitat in the LCR by being instrumental in developing a management plan for this river.

This element remains very important to the survival of the humpback chub in Grand Canyon. Reclamation has, through contracts with the Navajo Nation, developed an extensive database for use in developing the plan. Reclamation will work with the Service, Navajo Nation, Hopi Tribe, National Park Service, Bureau of Indian Affairs, AGFD, and others to develop a management plan that includes actions to avoid possible adverse impacts to humpback chubs and their spawning and rearing habitats in the LCR. The principle objective of this plan shall be the protection of humpback chub habitat in the Colorado River and LCR. A draft plan will be prepared within 2 years from the date of this biological opinion and transmitted to agencies, parties, and others having authority to implement the plan.

Status 2.

When the Service issued its first review in April 1997, we were awaiting a draft document. We have recently received a report titled "Strategies for Developing the Little Colorado River Management Plan." We understand this project was delayed in 1998.

Element 3.

Develop actions that will help ensure the continued existence of the razorback sucker by first sponsoring a workshop within 1 year following the biological opinion to enlist the advise of species experts, endangered fish researchers in Grand Canyon, Native Fish Work Group biologists, and others, such as Colorado River Recovery Team members, to develop a management plan for the species in the Grand Canyon. Following review of the workshop results, the Service will recommend a course of action and develop a Memorandum of Understanding with Reclamation and other entities who may wish to participate. The memorandum will provide detail on development of the management plan and implementation of actions identified in the plan.

Activities establishing razorback suckers in the Grand Canyon might include development of spawning and rearing areas that would function like flooded river bottom lands. Opportunities for such actions could be at (1) Lee's Ferry in a former gravel storage area along the mainstem and Paria River or (2) near the inflow area of the Colorado River into Lake Mead (Lake Mead National Recreation Area and Hualapai Indian Reservation). Cooperation of land managing agencies, such as the National Park Service and Hualapai Indian Tribe would be necessary.

Status 3.

The Service appreciates that the razorback sucker workshop has been completed. One of the goals of the workshop was to develop a management plan for the species in Grand Canyon. As stated in our April 3, 1997, review memorandum, the Service questions whether the workshop met its intended goals of developing a management plan. Perhaps it was over ambitious of us to expect a management plan to be completed in a two day workshop. We understand that a second workshop will not be held. Nevertheless, the Service is left to recommend a course of action with incomplete information. Some of the action items that were recommended from the workshop that the Service would like to further explore include:

1. Introduce large (>250 mm) razorback sucker to Lake Mead and track their habitat use and success.

2. Explore possibility of habitat use and success of augmented razorback sucker population, and implement if considered feasible.

3. Reduce non-native fish and explore management strategies for control of non-native fish.

4. Define source of razorback sucker prior to stocking (identify genetic stock for any stocking effort).

We realize that each one of the above mention items will require considerable amounts of time and money. A revised Recovery Plan for the razorback sucker was completed by the Service in December 1998. Further, Integration Report by SWCA summarizes data which suggests that razorback suckers were never common in Grand Canyon, and may not be in the future. Nevertheless, decline of the razorback sucker has been so extensive that it now only occupies a small fraction of its historic range. The designation of the Colorado River as critical habitat for the razorback sucker from the Paria River to Hoover Dam in 1994, was included to helps focus conservation activities because the area contains essential habitat features (primary constituent elements) that could be crucial to the long-term survival and recovery of the species. We believe a small but viable population of razorback suckers in Grand Canyon should be pursued. An evaluation of recovery sites that provide spawning, nursery areas, floodplain, temperature requirements and other aspects should be explored for suitability or restoration potential. We invite the Bureau of Reclamation to explore this issue with the Service.

Element 4.

Establish a second spawning aggregation of humpback chub downstream of Glen Canyon Dam.

Baseline information on possible tributary use or suitability for use by spawning humpback chub is being collected. Using that information, information from other Grand Canyon endangered fish research, and information from studies of *Gila* taxonomy, Reclamation, in consultation with the Service, National Park Service, AGFD, and land management agencies such as the Havasupai Tribe, will make every reasonable effort through funding, facilitating, and provide technical assistance to establish a program for additional spawning aggregations (or populations depending on genetic status) in the mainstem or tributaries. This effort has been identified as one of the EIS common elements.

Status 4.

Information collected on tributaries, backwater and nearshore use, and the aquatic food base will provide useful baseline information for the completion of this element. We value the collection of background information, however, the Service believes there has not been attention directly related to implementation of this element in 1998. Certainly some of the background

information gathered will be useful for the completion of this element. However, information specifically related to determining the future of a second population, including information on the genetic differences between humpback chub in the LCR versus the other aggregations, has not been identified.

In your February 25 memorandum, Reclamation states that establishment of the second population is largely dependent upon warmer water, while success is likely dependant on the temperature control device, and/or implementation of low steady summer flows. We mostly agree with this assessment. We also encourage Reclamation to take advantage of the opportunity to evaluate the relationship between mainstem flows and the conditions at RM 30 where warm springs host an aggregation of humpback chub. An evaluation of whether optimal flow conditions may increase the likelihood of spawning, egg incubation, larval survival, and recruitment could be initiated before the temperature control device. We understand that a contract to plan for a second population of humpback chub in Grand Canyon has been granted in fiscal year 1999. The Service looks forward to the conclusions of this contract and will provide review and recommendations when requested.

This concludes the Service review of the progress of implementation of the 1994 biological opinion. The Service appreciates your cooperation and the continued diligence of your staff. If you have any questions or if we can be of further assistance, please contact Debra Bills (x239), Don Metz (x217) of this office or Ren Lohoefener (505)248-6667 in Albuquerque.

for David L. Harlow

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (GM-AZ/NM)
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Director, Cultural Preservation Office, Hopi Tribe, Kykotsmovi AZ
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Director, Navajo Nation Historic Preservation Dept., Navajo Nation, Window Rock, AZ
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In Reply Refer to:
AESO/SE
2-21-93-F-167

June 13, 2002

Memorandum

To: Regional Director, Bureau of Reclamation, Salt Lake City, Utah

From: Field Supervisor

Subject: Review of Sufficient Progress in Implementation of the Elements of the Reasonable and Prudent Alternative from the December 21, 1994, Biological Opinion on the Operations of Glen Canyon Dam

This is in response to your May 8, 2002, memorandum to the Fish and Wildlife Service which summarizes the Bureau of Reclamation's evaluation of the progress during 2001 regarding implementation of the subject December 1994 Biological Opinion to remove jeopardy to the humpback chub (*Gila cypha*) and razorback sucker (*Xyrauchen texanus*). Debra Bills, Tom Gatz, and Don Metz of this office have discussed the issues informally with Dennis Kubly and Randy Peterson of your staff. This memorandum serves as our official review of the status during 2001. The Reasonable and Prudent Alternatives are repeated below in *italics*, followed by the status of each element.

Element 1.

Attainment of riverine conditions that support all life stages of endangered and native fish species is essential to the Colorado River ecosystem. Therefore, Reclamation shall develop an adaptive management program that will include implementation of studies required to determine impacts of flows on listed and native fish fauna, recommend actions to further their conservation, and implement those recommendations as necessary to increase the likelihood of both survival and recovery of the listed species.

The Adaptive Management Program, an EIS common element, was still being formulated as we prepared th(e) biological opinion. The Service supports adaptive management as an iterative approach to resource management. We recognize that the aquatic and terrestrial ecosystems below Glen Canyon Dam are still adjusting to impacts from dam operations that will continue into the future. Thus, the need for adaptive management. Actions taken through this approach must be based on integrated resource approach, and, as discussed by Hilborn[1] (1992) an active rather than a passive learning system that includes deliberative experimental design.

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[1] Hilborn, R. 1992. Can fisheries agencies learn from experience? Fisheries 17(4):6-14.

Status 1.

The Adaptive Management Work Group (AMWG) began meeting in September 1997. The Service joins Reclamation and the other stakeholders on the AMWG and the Technical Work Group (TWG). This task has been completed. We greatly appreciate Reclamation joining the Service in continuing to advocate actions to the AMWG and TWG that will further species conservation. We look forward to the continued implementation of those recommendations which will increase the likelihood of both survival and recovery of the listed species.

Element 1A.

A program of experimental flows will be carried out to include high steady flows in the spring and low steady flows in summer and fall during low water years to verify an effective flow regime and to quantify, to the extent possible, effects on endangered and native fish. Studies of high steady flows in the spring may include studies of habitat building and habitat maintenance flows. Research design and hypotheses to be tested will be based on a flow pattern that resembles the natural hydrograph, as described for those seasons in the SASF (seasonally adjusted steady flow).

Information from final GCES endangered fish reports, researchers who conducted those studies, and other knowledgeable individuals will be used to assist in determining an experimental flow regime of high spring flow and low summer and fall flow for endangered fishes and to develop hypotheses and studies to accompany those flows with final review and approval by the Service. Reclamation will provide technical assistance and funding.

Design of the experimental flows and associated studies will begin as soon as possible and be targeted for completion by October 1996. Unless the Service determines information provided seriously questions the validity of experimental designs developed or contribution of the resulting data to remove jeopardy to the federally-listed aquatic fauna of the Grand Canyon, experimental flows will be initiated in April 1997. If sufficient progress and good faith effort are occurring toward initiating experimental flows, implementation of experimental flows may occur later in 1997. If the Service believes there is not sufficient progress, Glen Canyon Dam would be operated as SASF flows during spring through fall (April to October) beginning in 1998. If the Service determines a study design can not be developed that is expected to provide information to support removal of jeopardy to the razorback sucker and humpback chub populations in the Grand Canyon and associated tributaries, such will be considered new information and may be grounds for reinitiating formal consultation.

This element is based on low release years (8.23 maf) occurring approximately 50% of the time. Further improvement of the means for determining a low water year that would initiate the implementation of research flows in a given year will be developed by Reclamation with concurrence by the Service. This may include, for example, methods based on content of water

in Lake Powell at a given date. When implemented, experimental flows will be conducted for a sufficient period of time to allow for experimental design, biological processes to function, and for variability inherent in riverine ecosystems to be expressed. The number of years to conduct the experimental flows is, therefore, indeterminate.

During moderate and high release years, Reclamation shall operate Glen Canyon Dam according to requirements of the MLFF. Operations during moderate and high water years would assist in achieving some of the variability that was always present in the historic Colorado River and under which the endangered and other native fish evolved.

Following analysis of the data, appropriate operational flows will be determined by the Service and implemented by Reclamation in compliance with section 7(a)(2), Endangered Species Act.

Status 1A.

This element has not seen sufficient progress. We agree with your assessment that the delay in developing this element is largely attributable to the program being part of the adaptive management process, where multiple objectives, research, and work assignments compete for the time and attention of the AMWG members. However, given the documented decline of the humpback chub in Grand Canyon, additional delays in developing a program of experimental flows for native fish should not occur.

Your May 8th memo states that a program of experimental flows will be developed and delivered to the AMWG by July 2002. While we support the upcoming flows for sediment conservation and acknowledge the urgent need for flows to disadvantage non-native species, these flows do not meet the objective of this portion of the Reasonable and Prudent Alternative. The program for experimental flows, as required in the biological opinion, should include high steady flows in the spring and low steady flows in summer and fall. Perhaps these experimental flows can not be implemented until after some other issues are addressed, e.g. mechanical removal of salmonids in the Little Colorado River or the temperature control device is in place. We defer to the researchers or science advisors on the best timing and conditions for these flows. Please consider immediate attention to this issue.

Element 1B.

Reclamation shall implement a selective withdrawal program for Lake Powell waters and determine feasibility using the following guidelines.

> *i. Review historic information and employ existing modeling with possible updates using alternative reservoir and operating conditions to prepare a set of possible scenarios of temperature changes in the mainstem.*
>
> *ii. Determine from the literature, experimentation, and consultation with the AGFD, Native American Tribes, National Park Service, Service, and other native fish species*

experts the anticipated effects on native fish populations which may result from implementation of temperature changes from a selective withdrawal structure. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval/juvenile growth and temperature.

iii. Assess the temperature induced interactions between native and non-native fish competitors and predators.

iv. Assess the effects of temperature, including seasonality and degree, on Cladophora and associated diatoms, Gammarus, aquatic insects, and fish parasites and disease.

v. Evaluate effects of withdrawing water on the heat budget of Lake Powell, effects of potentially warmer inflow into Lake Mead, and the concomitant effects on the biota within both reservoirs. Evaluate the temperature profiles along with heat budget for both reservoirs.

vi. Evaluate effects of reservoir withdrawal level on fine particulate organic matter and important plant nutrients to understand the relationship between withdrawal level and reservoir and downstream resources.

Installation of a selective withdrawal structure at Glen Canyon Dam may be essential in order to increase water temperatures downstream. Warmer mainstem temperatures are needed to ensure successful spawning and recruitment of endangered and native fishes in the mainstem. Research identified for this element should be integrated or combined with the research program specified in Element C. A selective withdrawal structure would provide considerable flexibility in managing the aquatic ecosystem downstream of Glen Canyon Dam. Management options, such as when to release warmer temperature water, seasonal patterns of releases to avoid establishment of permanent backwater areas, and use of floods, would all be available to limit expansion or invasion of non-native fish species.

The Service cautions the selective withdrawal structure should not be considered the only action needed to provide successful mainstem spawning and recruitment and ultimate recruitment for the humpback chub and razorback sucker. Aspects of the natural hydrograph, including low, steady releases in the summer, are considered necessary based on present knowledge of the temperature capabilities of a selective withdrawal structure and habitat requirements of the species. Future studies might identify opportunities to operate Glen Canyon Dam in a manner that would alleviate conditions that jeopardize the continued existence of listed fish in the Grand Canyon and minimize impacts on water utilization for power production and other purposes. This program also is one of the EIS common elements.

Status 1B.

The Service acknowledges that Reclamation has made progress in developing a program for the selective withdrawal program. Although a draft environmental assessment was prepared and a

workshop was held in 1999, progress on this element has been slow since then. We look forward to receiving the feasibility evaluation for the temperature control device expected later this year.

Element 1C.

Determine responses of native fishes in Grand Canyon to various temperature regimes and river flows of the experimental flows and other operations of Glen Canyon Dam. Studies will emphasize collection of information necessary to remove jeopardy to federally-listed species and identify actions necessary to enhance their recovery. Reclamation will provide technical assistance and funding for research to accomplish the following studies.

i. Determine the effects of water temperature on reproductive success, growth, and survivorship of Grand Canyon fishes.

ii. Determine relationships among tributary hydrology, reproductive success of fishes, and the abundance of fishes in mainstem rearing habitats.

iii. Determine the effects of mainstem hydrology on the number of nearshore rearing habitats, environmental conditions in these habitats, and their successful utilization by fishes.

iv. Assess biotic interactions between native and non-native fishes, particularly those that occur in nearshore rearing habitats affected by dam operations.

v. Determine humpback chub life history schedule for populations downstream of Glen Canyon Dam.

vi. Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources.

vii. Determine the effects of dam operations, including modifications to regulate water temperatures, on the parasites and disease organisms of endangered and native fishes in Grand Canyon.

Emphasis should be placed on experimental approaches using various flow and temperature scenarios to determine cause and effect relationships between dam operations and responses of the community of endangered and native fishes endemic to the Grand Canyon. Efforts should be hypotheses driven and specific in objectives. Explanation of the above research efforts is provided in Appendix 1 (not included here) along with suggested hypotheses. The success of these research efforts will require sufficient flexibility in operations to design and carry out the experiments. Wherever feasible, off-site experiments should be considered as a means of generating or supporting the testing of hypotheses to reduce on-site study time and complexity.

Long-term measurements should more appropriately be incorporated into the monitoring program, but there must be an active synergism between the two efforts.

The long-term monitoring plan should define objectives and methods for tracking the status of native fishes in Grand Canyon. Relevant indices should be developed and measured in support of the long-term monitoring plan. A major advantage of the current intensive marking studies using passive integrated transponder tags is the ability to measure future movements, growth rates, and population sizes of these fishes. This legacy, and others made available by this period of intensive research effort, should be effectively incorporated into the long-term monitoring program for fishes. Adaptive management, an EIS common element, would likely include a number of the above research objectives.

Status 1C.

This item is progressing well. We appreciate the reports and information presented at TWG and AMWG meetings, and at various symposiums.

Element 2.

Protect humpback chub spawning population and habitat in the LCR by being instrumental in developing a management plan for this river.

This element remains very important to the survival of the humpback chub in Grand Canyon. Reclamation has, through contracts with the Navajo Nation, developed an extensive database for use in developing the plan. Reclamation will work with the Service, Navajo Nation, Hopi Tribe, National Park Service, Bureau of Indian Affairs, AGFD, and others to develop a management plan that includes actions to avoid possible adverse impacts to humpback chubs and their spawning and rearing habitats in the LCR. The principle objective of this plan shall be the protection of humpback chub habitat in the Colorado River and LCR. A draft plan will be prepared within 2 years from the date of this biological opinion and transmitted to agencies, parties, and others having authority to implement the plan.

Status 2.

Little progress has occurred on this item. We appreciate your recent efforts to work with the Little Colorado River Multi-Objective Management watershed group (LCR-MOM), who has already established a network among local, county, tribal, and private entities. We will assist in the effort. We look forward to receiving your June 2003 document.

Element 3.

Develop actions that will help ensure the continued existence of the razorback sucker by first sponsoring a workshop within 1 year following the biological opinion to enlist the advise of

species experts, endangered fish researchers in Grand Canyon, Native Fish Work Group biologists, and others, such as Colorado River Recovery Team members, to develop a management plan for the species in the Grand Canyon. Following review of the workshop results, the Service will recommend a course of action and develop a Memorandum of Understanding with Reclamation and other entities who may wish to participate. The memorandum will provide detail on development of the management plan and implementation of actions identified in the plan.

Activities establishing razorback suckers in the Grand Canyon might include development of spawning and rearing areas that would function like flooded river bottom lands. Opportunities for such actions could be at (1) Lee's Ferry in a former gravel storage area along the mainstem and Paria River or (2) near the inflow area of the Colorado River into Lake Mead (Lake Mead National Recreation Area and Hualapai Indian Reservation). Cooperation of land managing agencies, such as the National Park Service and Hualapai Indian Tribe would be necessary.

Status 3.

The Service appreciates that the razorback sucker workshop has been completed. One of the goals of the workshop was to develop a management plan for the species in Grand Canyon. As stated in our earlier reviews of sufficient progress, the Service questions whether the workshop met its intended goals of developing a management plan. Perhaps it was overly ambitious of us to expect a management plan to be completed in a two-day workshop. We understand that a second workshop will not be held. Nevertheless, the Service is left to recommend a course of action with incomplete information. Some of the action items that were recommended from the workshop that the Service would like to further explore include:

1. Introduce large (>250 mm) razorback sucker to Lake Mead and track their habitat use and success.

2. Explore possibility of habitat use and success of an augmented razorback sucker population, and implement if considered feasible.

3. Reduce non-native fish and explore management strategies for control of non-native fish.

4. Define source of razorback sucker prior to stocking (identify genetic stock for any stocking effort).

The decline of the razorback sucker has been so extensive that it now only occupies a small fraction of its historic range. The designation of the Colorado River as critical habitat for the razorback sucker from the Paria River to Hoover Dam in 1994 was included to help focus conservation activities because the area contains essential habitat features (primary constituent elements) that could be crucial to the long-term survival and recovery of the species. We believe

a small but viable population of razorback suckers in Grand Canyon should be pursued. An evaluation of recovery sites that provide spawning, nursery areas, floodplain, temperature requirements and other aspects should be explored for suitability or restoration potential. We invite the Bureau of Reclamation to explore this issue with the Service.

Element 4.

Establish a second spawning aggregation of humpback chub downstream of Glen Canyon Dam.

Baseline information on possible tributary use or suitability for use by spawning humpback chub is being collected. Using that information, information from other Grand Canyon endangered fish research, and information from studies of Gila taxonomy, Reclamation, in consultation with the Service, National Park Service, AGFD, and land management agencies such as the Havasupai Tribe, will make every reasonable effort through funding, facilitating, and provide technical assistance to establish a program for additional spawning aggregations (or populations depending on genetic status) in the mainstem or tributaries. This effort has been identified as one of the EIS common elements.

Status 4.

Information collected on tributaries, backwater and nearshore use, non-native fish species, and the aquatic food base will provide useful baseline information for the completion of this element. We value the collection of background information, however, the Service believes there has not been sufficient attention to this element in 2001. Certainly some of the background information gathered will be useful for the completion of this element. However, information specifically related to determining the future of a second population, including information on the genetic differences between humpback chub in the LCR versus the other aggregations, has not been identified.

This concludes the Service's 2001 review of the progress of implementation of the 1994 biological opinion. We appreciate your cooperation and the continued diligence of your staff. If you have any questions or if we can be of further assistance, please contact Debra Bills (x239), Don Metz (x217).

for David L. Harlow

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