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**Subject:** draft warm water plan

Please find attached a DRAFT warm water nonnative species research plan.

Please provide this to the TWG in preparation for their January 25-26 meeting. **It should be noted that this plan includes ALL comments received from participants and reviewers as of 11 am today, 17 Jan. I expect that, together with the TWG, we will be editing the document and potentially eliminating some proposed projects.** I will plan to present this information using a Power Point presentation.

Thank you

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**Warm Water Nonnative Aquatic Species in the Grand Canyon**  
**DRAFT Research and Treatment Plan Outline**  
**Prepared by:**  
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## **I. Introduction**

On August 11, 2004 the AMWG passed the following motion: “*...GCMRC and TWG make a recommendation to AMWG in October 2004 on warm water species studies including a plan starting in January 2005*”. Subsequently on September 27, 2004 the TWG passed an additional motion: “*GCMRC will develop a process, a schedule, and a recommended budget for suppression and control of non-native fish (warm water species) to be presented to AMWG at their October meeting*”. GCMRC staff presented a prospectus for research and monitoring in response to the various motions listed above at the October, 2004 meeting. As part of this prospectus, GCMRC recommended convening a workshop to obtain input into the planning process. GCMRC subsequently received AMWG approval to host the workshop.

In December 2005 a workshop to address existing and potential issues associated with warm water nonnative species was held in Flagstaff, Arizona. The meeting was attended by fisheries professionals working on similar issues throughout the Colorado River basin, TWG members representing several stakeholder groups, and fisheries professionals from outside the basin with expertise deemed helpful in guiding the planning process. During the first and second days, the group heard presentations from attendees regarding: planning for non-native control (risk analysis, management issues, strategies), case studies of mechanical removal programs in other areas, overview of current work in Grand Canyon, species specific capture and detection techniques used in other systems, and recent research and potential applications of bio-control techniques. Distributed among the presentations was limited discussion of management issues associated with nonnative species, potential control options, and research and monitoring issues. An additional half day was utilized to develop a list of recommendations and issues that the fisheries professionals felt important for managers to consider (see below). The group also developed some outlines of potential research programs to address critical information needs associated with warm water nonnative issues in Grand Canyon. The remainder of this document outlines a proposal for non-native research and monitoring to be conducted by the GCDAMP. Because this is a multi-faceted issue that represents a new initiative for the AMP, the addition of a full-time GCMRC staff biologist is recommended to lead the effort.

Because the trout removal project has had some success and because total funding is limited it is anticipated that a warm water species control initiative will be funded, at least in part, by funds currently being applied to trout removal. The trout removal project would have to be reduced to accommodate this funding approach.

**Nonnative Warm Water Aquatic Biota Management Actions developed by attendees at the December 2005 workshop:**

1. Develop nonnative and native fish management policies.
2. Pre-invasion risk assessment; identify spatial extent of potential impacted populations and nonnative source systems; prioritize areas by likelihood of severe impacts; identify agency authorities and responsibilities.
3. Prevent invasions
4. Post-invasion assessment of impacts of nonnative fish on native fish populations, including prioritization of problem species (impacts to specific native fish species and life history stages, reproductive potential, migratory habits, geographic extent, etc) and probable impact mechanisms.
5. Development of coordinated nonnative fish control strategies; identify conflicts (sport fishing, agency jurisdiction/policy, etc).
6. Develop list of acceptable control methods (chemical, biological, etc.)
7. Identification and use of cost-effective nonnative fish control methods.
8. Development of programs to monitor results of nonnative fish control measures.
9. Assure I & E and Outreach programs are in place to communicate intentions and findings to the public.
10. Managers consult fish experts on critical fish related issues and prior to fish related decisions.
11. Establish list, including flows, of emergency actions based on specific trigger points (including juvenile native fish concerns).
12. Integrate with science planning group, particularly related to long-term experimental planning.
13. AMWG should work with Upper Basin, Missouri River stakeholders, and others to pursue issues regarding use of genetically modified species, especially crayfish.
14. The presence of yet another threat to native fishes, i.e., warm water nonnative species, suggests that it is important to pursue development of strategies for holding and rearing humpback chub in captivity.
15. Seek funding from other AMP participating agencies.

## **II. Risk**

- a. Problem Statement. The nonnative warm water species that pose the greatest risk to native fishes in the Grand Canyon are not known with certainty.
- b. Questions.
  - i. Which species currently prey on/compete with native fishes?
  - ii. Which species may be expected to prey on/compete with native fishes?
  - iii. Which nonnative species are currently in the Colorado River and Little Colorado River in Grand Canyon?
  - iv. Which nonnative species have access to Grand Canyon, either from upstream or downstream?
- c. Research
  - i. BOR contracted research on warm water nonnative species has begun and continues. Expect this will assemble life histories and potential vulnerabilities of these species.
  - ii. Need: risk assessment of nonnative aquatic species to determine what one or more species pose the greatest risk to native fishes. Should address:
    - 1. Which species are now present in the Grand Canyon ecosystem?
    - 2. Which species are/will prey on native fishes?
    - 3. Which species are/will alter native aquatic habitats?
  - iii. Sources. This information will also impact analysis of control measures. Expect that the sources of greatest concern are the Colorado River and Little Colorado River.
    - 1. Additional sources, in order of importance
      - a. Lakes Powell and Mead
      - b. Tributaries
      - c. Upstream sources
    - 2. Need: risk analysis of fishes currently in Grand Canyon and comparative analysis of potential sources
- d. Projects
  - i. BOR research on warm water nonnative fishes includes risk of invasion based on life histories. Continue (no cost to AMP)
  - ii. Risk analysis. Initiate in 2006. AMP funded. Incorporate BOR study as appropriate. Deliver draft report early 2007.
  - iii. Monitor nonnative species sources and initiate policies and control as necessary. Initiate in 2006. May be cost shared with partner agencies.
  - iv. Policy review of nonnative control. AZGF conducts with GCMRC input as requested, reports back to AMP.
  - v. Conduct *ex situ* and *in situ* experiments to distinguish and determine roles of competition and predation between warm water nonnative and native fishes.
  - vi. Develop a rapid response plan

### **III. Water Quality Monitoring**

- a. Problem statement: Fall 2005 releases from Glen Canyon Dam were warmer than historic temperatures. Lower dissolved oxygen accompanied these releases. Monitoring has allowed development of temperature profiles in the mainstem in the Grand Canyon. Water temperature modeling has been initiated by GCMRC. A better understanding of how native and nonnative fishes will respond to warmer than historic (since 1964) river temperatures is needed. Use of a Selective Withdrawal Structure could alter Glen Canyon Dam releases, seasonally and cumulatively, depending on operational criteria.
- b. Questions
  - i. What is the temperature profile of the Colorado River in Grand Canyon historically and currently?
  - ii. Does dissolved oxygen remain at safe levels for aquatic life throughout the Grand Canyon?
  - iii. Will operation of a SWS for warming increase the chances of intercepting the late summer/fall low dissolved oxygen below the surface?
  - iv. How are native and nonnative fishes responding to the current temperatures and dissolved oxygen, and how can they be anticipated to react to future temperatures and oxygen levels?
  - v. Where are the habitats with the warmest temperatures and other favorable habitat features for native fishes, e.g., substrates, cover, depth?
  - vi. Will other water quality factors altered by operation of a SWS affect the downstream fishery, ecosystem, and food web?
- c. Research
  - i. Need: refined temperature and chemical profiles in Colorado River in Grand Canyon
  - ii. Identify the downstream location where re-aeration reaches acceptable safe levels over various seasonal, climatic, and operational scenarios.
- d. Projects
  - i. Temperature and water quality monitoring of Colorado River in Grand Canyon and Lake Powell
  - ii. Temperature and water quality modeling of Colorado River in Grand Canyon and Lake Powell

### **IV. Fish Monitoring**

- a. Problem statement: Current monitoring and research does not characterize, with satisfactory accuracy and precision, the distribution and abundance of native and nonnative fishes and crayfish in Grand Canyon. Methods need to minimize impacts to native fishes.
- b. Questions
  - i. Where are native fishes found in the Grand Canyon?
  - ii. What are the population dynamics of native fishes in the Grand Canyon?
  - iii. Where are nonnative fishes found in the Grand Canyon?

- iv. What are the population dynamics of nonnative fishes in the Grand Canyon?
- c. Research
  - i. Need: Effective, and ideally less invasive, methods for detecting fishes in the GC.
- d. Projects
  - i. Continue investigation into the use of acoustic technologies to help monitor and assess native and nonnative fishes. Begin in 2006.
    - 1. Acoustic camera can be utilized to locate fish assemblages
    - 2. Acoustic tagging can be utilized to document fish movement
  - ii. Begin movement studies of nonnative fishes in the Little Colorado River, inner gorge tributaries, and nearby mainstem locations. Begin LCR work in 2006. Begin inner gorge work in 2007 in coordination with National Park Service
  - iii. Increase monitoring in mainstem beginning in 2006 in order to increase documentation of fish species, fish distributions, and gear effectiveness.
  - iv. Use remote PIT tag monitoring stations to document movement of tagged (especially native) fishes.

## V. Control

- a. Problem statement: How do we control nonnative warm water species in Grand Canyon?
- b. Questions
  - i. Are current aquatic habitat management policies sufficient to control additional influx of nonnative warm water species (fishes and crayfish)? If not, how should they be changed?
  - ii. In what locations in the Colorado River and tributaries is control of nonnative species most important to benefit native species?
  - iii. What locations in the Colorado River and tributaries are the most important to control nonnative fishes and crayfish in order to limit their abundance and distribution?
  - iv. To what degree does the LCR contribute nonnative species to the Grand Canyon?
  - v. Do warm water nonnative species use the LCR as a spawning and rearing area?
  - vi. How important are inner gorge tributaries (e.g., Bright Angel Cr., Clear Cr.) in contributing nonnative fishes to the system, e.g., brown trout?
  - vii. How do brown trout use inner gorge tributaries as spawning and rearing areas?
  - viii. What is the relative importance of crayfish in the system?
  - ix. Will incidence of Asian tapeworm infection increase in the presence of warmer water? Are there acceptable methods for the treatment of individual fish?
- c. Research

- i. Need: methods and gear analysis
  - 1. After identifying one or more most threatening species, what will be the most effective way(s) to capture and control these species?
  - 2. What results can and cannot be expected? It should be recognized from the start that we are unlikely to ever remove all nonnative species from the system
- ii. Sources. This information will also impact risk analysis. Expect that the sources of greatest concern are the Colorado and Little Colorado rivers.
  - 1. Additional sources, in presumed order of importance
    - a. Lakes Mead and Powell
    - b. Tributaries
    - c. Upstream sources
  - 2. Need: source analysis of fishes and crayfish currently in Grand Canyon and comparative analysis of potential sources
  - 3. Need: Better understanding of the use of LCR and inner gorge tributaries as sources of nonnative fishes and crayfish
- d. Projects
  - i. Methods and gear analysis. Initiate in FY 2007. AMP funded.
  - ii. Monitor nonnative species sources and initiate policies and controls as necessary. Initiate in 2006 and 2007. May be cost shared with partner agencies.
    - 1. Work in LCR and LCR Inflow to understand movement dynamics and life history of channel catfish and common carp in critical humpback chub habitat. Initiate in 2006 and piggyback on LCR monitoring and Mechanical Removal Work.
    - 2. Work in inner gorge tributaries to understand movement dynamics and life history of Brown Trout. Initiate in 2007 in coordination with NPS.
  - iii. Using sonic-tagged nonnative fishes, especially channel catfish, smallmouth bass, and common carp, investigate the proportion of fish vulnerable to capture with different gear types
  - iv. Determine distribution and relative abundance of crayfish in the Grand Canyon
  - v. In cooperation with other programs and agencies, support research into genetic control of crayfish
  - vi. Investigate safety, effectiveness, and necessary authorities for treating individual humpback chub with praziquantel