U.S. Bureau of Reclamation Upper Colorado Region

THE POTENTIAL OF HABITAT FOR THE RAZORBACK SUCKER IN THE LOWER GRAND CANYON AND COLORADO RIVER INFLOW TO LAKE MEAD

A SCIENCE PANEL REPORT

Salt Lake City, Utah Final Report – April 2012

Cover Photo:

Aerial view of lower Grand Canyon (R. Valdez, June 24, 1992).

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Report Number 2

THE POTENTIAL OF HABITAT FOR THE RAZORBACK SUCKER IN THE LOWER GRAND CANYON AND COLORADO RIVER INFLOW TO LAKE MEAD

A SCIENCE PANEL REPORT

Final Report

REPORT TO U.S. BUREAU OF RECLAMATION
UPPER COLORADO REGION
SALT LAKE CITY, UTAH

REPORT OF INDEPENDENT SCIENCE PANEL

Richard Valdez (chair), Chuck McAda, Gordon Mueller,
Dale Ryden, and Melissa Trammell

APRIL 1, 2012

PREFACE

The U.S. Bureau of Reclamation (Reclamation) has undertaken an investigation to examine the potential of habitat for the federally endangered razorback sucker (*Xyrauchen texanus*) in the lower Grand Canyon. Reclamation, in collaboration with the U.S. Fish and Wildlife Service (USFWS), is investigating the potential for establishment of the razorback sucker in the lower Grand Canyon and may institute an augmentation program for the species in that area, if appropriate. This investigation addresses part of a conservation measure of the Final Environmental Impact Statement for the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead. The measure is contained in Concurrences (Appendix A) of the 2007 Biological Opinion for that action which states that: *"Reclamation will, as a conservation measure, undertake an effort to examine the potential of habitat in the lower Grand Canyon for the species* [razorback sucker]*, and institute an augmentation program in collaboration with FWS, if appropriate."*

Reclamation is coordinating this investigation with the U.S. Fish and Wildlife Service, Glen Canyon Dam Adaptive Management Program, Lower Colorado River Multi-Species Conservation Program, National Park Service, Grand Canyon Monitoring and Research Center, Nevada Department of Wildlife, Arizona Game and Fish Department, and the Hualapai Tribe. SWCA, Environmental Consultants was retained by Reclamation to assist with the assimilation of information for this investigation and to recommend an augmentation strategy for the razorback sucker. SWCA and Reclamation established three tasks: (1) assimilate, review, and summarize the habitat information for the species, (2) convene a Science Panel of species experts for recommended actions, and (3) develop a recommended augmentation strategy.

This report is the second of three reports produced as part of this investigation that include::

1. *Review and Summary of Razorback Sucker Habitat in the Colorado River System*: This report summarizes habitat used by the razorback sucker throughout its range in the Colorado River System, including conditions for spawning and egg incubation; larval drift corridors and distances; nurseries used by young; juvenile rearing areas; food requirements; movement; and subadult and adult habitat. The information contained in this report was used to better gauge the suitability of conditions for the species in the lower Grand Canyon and Colorado River inflow.

2. *The Potential of Habitat for the Razorback Sucker in the Lower Grand Canyon and Colorado River Inflow to Lake Mead: A Science Panel Report*: This report contains the views, opinions, and recommendations of a panel of species experts on the suitability of the lower Grand Canyon and Colorado River inflow for the razorback sucker. It was developed from a reconnaissance field trip and meetings of the Panel in September, 2010.

3. *Strategy for Establishing the Razorback Sucker in the Lower Grand Canyon and Lake Mead Inflow*: This report describes a strategy for establishment of the razorback sucker in the lower Grand Canyon, either naturally through expansion of the Lake Mead population or possibly through augmentation.

ACKNOWLEDGMENTS

The U.S. Bureau of Reclamation and SWCA Environmental Consultants appreciate the efforts of many individuals that provided support and input into this investigation and the development of the three reports (see names and affiliations below). Mark McKinstry, Reclamation's Contract Officer Technical Representative, provided the impetus, support, and guidance for this project. We thank the members of the Science Panel (highlighted below) for their critical review, evaluation, and input necessary to the development of a scientifically defensible approach for evaluating the potential for introducing razorback suckers into the lower Grand Canyon.

We thank the National Park Service for their collaboration and support of this project, especially Brian Healy, Emily Omana Smith, Nate Alvord, and Dave Loeffler of Grand Canyon National Park who provided logistical support and rafts for the reconnaissance field trip of September 16-19, 2010, through the lower Grand Canyon. We thank Greg Squires of Lake Mead National Recreation Area for providing a boat to transport the Science Panel in the Lake Mead inflow.

We thank the participants of the reconnaissance field trip for their valuable time and insight and the agencies for supporting members of their staffs to participate in this process. The Bar 10 Ranch provided aerial and ground transportation from Flagstaff, Arizona to Whitmore Wash.

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1.0 INTRODUCTION

1.1 Role of the Science Panel

The U.S. Bureau of Reclamation (Reclamation), as part of a 2007 Biological Opinion (USFWS 2007), has undertaken an effort to examine the potential of habitat for the federally endangered razorback sucker (*Xyrauchen texanus*) in the lower Grand Canyon. Reclamation, in collaboration with the U.S. Fish and Wildlife Service (USFWS), may institute an augmentation program for the species, if appropriate. This report presents the results of an evaluation by an independent scientific review panel (Science Panel) and summarizes their recommendations on three key questions:

1. Is the habitat of the lower Grand Canyon and Lake Mead inflow suitable for the razorback sucker?
2. Should Reclamation and the USFWS proceed with efforts to introduce razorback suckers into the lower Grand Canyon?
3. If appropriate, what methods or strategies should be considered in introducing razorback suckers into the lower Grand Canyon?

1.2 Members of the Science Panel

A list of prospective panelists was compiled by SWCA, a contractor to Reclamation for this project. Reclamation and SWCA selected panelists based on their availability and expertise of the subject matter. It was desirable to have a cross-section of species experts with experience and expertise in the lower and upper basins of the Colorado River System. The primary evaluation factors for choice of panelists were:

- Past or ongoing experience in the Colorado River System with the razorback sucker;
- A history of research, involvement, and knowledge of water and biological issues in the Colorado River System; and
- The ability to provide an objective and unbiased view of current policies and decisions that affect the razorback sucker in the Colorado River System.

Members of the Science Panel were as follows (see Appendix A for titles and publications):

- Chuck McAda: U.S. Fish and Wildlife Service (retired).
- Gordon Mueller: U.S. Geological Survey (retired).
- Dale Ryden: U.S. Fish and Wildlife Service.
- Melissa Trammell: National Park Service.
- Richard Valdez (chair): SWCA, Environmental Consultants.

1.3 Evaluation Process

Members of the Science Panel were requested to address the three key questions identified in section 1.1 above. The following steps were taken to assist the Panel with an evaluation of the available scientific information and to facilitate addressing the questions and the formulation of recommendations:

- **Review of Habitat Information**: The panelists were each provided with a Draft Report of a "Review and Summary of Razorback Sucker Habitat in the Colorado River System" (Valdez et al. 2012a) This report summarized habitat used by the razorback sucker throughout its range in the Colorado River System, including conditions for spawning and egg incubation; larval drift corridors and distances; nurseries used by young; juvenile rearing areas; food requirements; movement; and subadult and adult habitat. The information contained in this report was provided to the Science Panel to help them better gauge the suitability of conditions for the species in the lower Grand Canyon and Lake Mead inflow. The panelists were familiar with most of the information provided and the report provided a synthesis of that information.
- **Reconnaissance Field Trip**: A field trip was organized and conducted by Reclamation and SWCA, in cooperation with the National Park Service, on September 16-19, 2010, from Whitmore Wash (RM 187) downstream to Pearce Ferry (RM 280). The purpose of the trip was to familiarize the Panel with this reach of the Colorado River and to provide a setting conducive to a focused evaluation of the information and the conditions of the lower Grand Canyon. The trip was also used as an opportunity to conduct a series of closed and open meetings of the Science Panel to address the key and specific questions (see sections 1.1 and 2.1). In addition to the Science Panel, 13 individuals from cooperating State and Federal agencies, a Native American Tribe, and private contractors were invited to participate in the trip to provide agency insight and their views on the potential for introducing razorback suckers into the lower Grand Canyon (see Preface and Acknowledgments).
- **Meetings of Science Panel**: The Science Panel was formally convened three times during and immediately after the reconnaissance field trip. Each of the meetings was restricted to the panelists and no observers or onlookers were allowed. In addition to these closed meetings, two meetings were held in which trip participants provided their opinions and exchange of views with the Science Panel. Notes on each meeting were recorded by SWCA.
- **Concurrence of Reports and Recommendations**: Following the completion of three reports on habitat of the razorback sucker (Report #1), evaluation and recommendations of the Science Panel (Report #2), and recommended establishment strategy (Report #3), a conference call was held with the members of the Science Panel to obtain concurrence on the scientific validity of the reports and on the accuracy of their conclusions and recommendations. No written dissenting opinions or views were issued by the panelists for the contents of this report or for the conclusions and recommendations.

2.0 DISCUSSION AND CONCLUSIONS

The Science Panel was presented with six specific questions to help direct their evaluation and recommendations with respect to the three key questions. The following is an overview of the discussions and conclusions reached by the Panel with respect to each of the specific questions. The discussions were captured and assimilated by the Science Panel chair, and responses by individual panelists are not provided because of the lengthy dialogue and discourse that ensued with each question. Notes on each meeting of the Science Panel were recorded by SWCA, but are not made available with this report because of their length and conversational nature.

2.1 Specific Questions Addressed by the Science Panel

The following specific questions were asked to be addressed by the Science Panel. The responses below were written by the Science Panel chair based on the recorded discussions that took place in the Science Panel meetings.

1. **What do you believe are the potential habitat attributes of western Grand Canyon and the Lake Mead inflow for the razorback sucker?**

   - **Basis of Information**: Of the five members of the Science Panel, three had previously visited or sampled fish in the lower Grand Canyon. One panelist had participated in a habitat reconnaissance of the lower Grand Canyon the year before the trip, and a second panelist had directed fishery investigations in this reach of the Colorado River in 1992 to 1995. The third panelist familiar with this reach of the Colorado River had visited the area in the 1980s. The panel members appreciated the information provided to them in Report #1, but requested additional and more specific information on the fish community and food base of the lower Grand Canyon. No food base information was available, but recent work in the Grand Canyon further upstream was included in a subsequent draft of the report.
   - **Visual Assessment of Habitat**: Members of the panel acknowledged that physical habitat in the lower Grand Canyon appeared to be within the range of habitats used by razorback suckers or in which they had observed the species in other parts of the basin. Although large floodplains are absent from lower Grand Canyon, panelists felt that small backwaters and a complex shoreline could provide nursery habitat for young suckers. However, the scientists expressed concern over the ephemeral nature of these habitats—including backwaters—caused by daily, monthly, and seasonal operations of Glen Canyon Dam. Panelists identified suitable habitats as shorelines with cobble and rock outcrops, inundated or over-hanging riparian vegetation, in-channel woody debris, alluvial cobble/gravel bars, and ephemeral backwaters. It was noted that backwaters regularly inundated and desiccated by dam operations are unstable and cause young fish to move periodically, exposing them to predation and possibly contributing to starvation. Seine hauls taken in backwaters during the reconnaissance field trip yielded numerous young flannelmouth suckers and bluehead suckers (native suckers commonly found with razorback suckers), indicating that the other native suckers are successfully using the lower Grand Canyon for at least rearing. The most apparent missing component of habitat

was the large floodplains complexes used by young razorback suckers as nurseries and rearing areas in some reaches of the Green and Upper Colorado rivers where the species persists, and in the Lower Colorado River Basin where the species was historically abundant. Some panelist contrasted and compared the habitat of the lower Grand Canyon with reaches elsewhere in the Colorado River System where there are few or no razorback suckers, such as the Colorado River between the Dolores River and Moab (i.e., "Daily Reach"), in Canyonlands National Park, or the lower end of the San Juan River (i.e., RM 68 downstream). The panelists requested more information on ecological attributes of the area (e.g., fish community, food base) to better assess habitat potential.

- **Conclusion**: The habitat of the lower Grand Canyon is not strikingly like those regions of the Colorado River System where the razorback sucker is abundant—or was historically abundant. This reach of the Colorado River could probably support small numbers of adult and subadult razorback suckers. There are some large cobble/gravel bars that could be used for spawning and there is a limited amount of nursery habitat that may be largely ephemeral, depending on dam operations. The area lacks the channel complexity, side channels, and oxbows that form large protected and productive habitats in which the species thrives in other parts of the basin. It also lacks the large floodplain habitats and complexes used by the young for nursing and rearing. There are low-lying tributary mouths that could serve as inundated floodplains (e.g., Burnt Spring Canyon, Clay Tank Canyon [Lost Creek]), but these are disconnected from the river by large sand/silt berms. The inaccessibility and remoteness of this region precludes the use of heavy equipment to mechanically remove these berms. Furthermore, the river flow in this reach is affected by releases from Glen Canyon Dam that vary seasonally and may inundate or isolate these floodplains in an unpredictable and unreliable manner.

2. Do you believe the region of the lower Grand Canyon and the Lake Mead inflow is currently suitable habitat for razorback sucker?

- **Species is Highly Adaptable**: One panelist was quick to point out that biologists and managers alike should not be too quick to pre-determine what river regions are suitable for the razorback sucker. In many places in the Colorado River System, the species has demonstrated high adaptability and use of a wide range of habitats. The razorback sucker is the only large-bodied fish species in the Colorado River System (except possibly for the bonytail) that spawns and recruits in riverine as well as reservoir and pond habitats.
- **Historic Habitat Distribution**: The historic distribution of the razorback sucker supports the hypothesis that there are large numbers of razorback suckers downstream of Grand Canyon because of habitat complexity, but the species is largely absent from the canyon because of the lack of that complexity. One panel member noted that this species historically was consistently found primarily in river reaches with large floodplains that became inundated with spring runoff and often held water year-around. Historic records indicate that the species probably used canyon-bound reaches transiently, possibly for spawning, feeding, and as passage between alluvial reaches and floodplains. Other panelists pointed out that the species is currently found in reaches of the Colorado River system absent of large floodplains, such as the San Juan River; or in locations in which it uses gravel pits as surrogates for floodplains, such as in the upper Colorado River near Grand Junction.

- **Lower Grand Canyon and Lake Mead Inflow Habitat Continuum**: Panel members felt that the most likely scenario for the razorback sucker to become established in the lower Grand Canyon is as an extension of the Lake Mead population. The river in the lower Grand Canyon apparently provides habitat for spawning, juveniles, and adults, but the nursery habitat is limited to ephemeral backwaters; the most suitable nursery and rearing habitat is downstream in the Lake Mead inflow, where larvae of presumably the Lake Mead population have been found.
- **Conclusion**: The physical habitat of the lower Grand Canyon appears to be marginally suitable for the razorback sucker with a variety of habitats that could be used by adults, subadults, juveniles, and possibly for spawning and rearing. However, the absence of large floodplains reduces the likelihood for a self-sustaining population reliant only on the lower Grand Canyon, and a connection with the Lake Mead inflow would be necessary to support all life stages. Possibly fish could spawn in the lower canyon and their young can drift to nursery habitat in the Lake Mead inflow.

3. What do you believe are the three most important actions that would need to be taken to establish the razorback sucker in the lower Grand Canyon and the Lake Mead inflow?

- **Assimilate Additional Information**: The reach of the Colorado River through the lower Grand Canyon (i.e., Diamond Creek to Pearce Ferry) has not been surveyed for fish as intensively as the river further upstream. Intensive investigations of the hydrology, sediment, food base, riparian vegetation, and fish community have been conducted in the river between Glen Canyon Dam and Diamond Creek (e.g., Gloss et al. 2005; Melis 2011), but relatively few studies have extended downstream. Panel members requested additional information on the contemporary fish community, habitat, and food base. The available information was provided from past investigations and studies of the Colorado River upstream of the lower Grand Canyon in Report #1 on habitat, but the ecological information on this reach of river is limited.
- **Initiate Fish Community Surveys**: The Science Panel felt that a fish community survey from Diamond Creek to Pearce Ferry is warranted to: (a) determine if razorback suckers are present in the area, (b) determine if fish from the Lake Mead population are using the lower Grand Canyon, (c) better understand from the present fish community if ecological conditions might be suitable for certain life stages of the razorback sucker.
- **Release Small Numbers of Sonic-Tagged Fish**. Small numbers of large sonic-tagged fish should be released at the beginning of fish community surveys to: (a) provide fish during the fish community survey for crews to track and better understand where to sample for razorback suckers, (b) determine if stocked fish will remain in the area, (c) determine habitat use, and (d) to help locate other razorback suckers in the area (i.e., Judas fish).
- **Conclusion**. Before proceeding with any efforts to introduce razorback suckers into the lower Grand Canyon, it should first be determined if the species is already present in the area and if the existing fish community shows that the area can support the species ecologically. Flannelmouth suckers are now common in the lower canyon and this species has similar ecological requirements, except possibly for large floodplains used as

nurseries by young razorback suckers. Fish community surveys should be conducted in the lower Grand Canyon, and small numbers of sonic-tagged fish should be released for tracking these fish simultaneous to the surveys.

4. If augmentation is appropriate, what do you believe would be the most effective fish introduction strategy?

- **Use Wild Conditioned Fish**. Members of the Science Panel urged the use of small numbers of wild fish of sufficient size, experience, and conditioning to avoid predation. These fish may be wild-caught larvae raised in protected, predator-free ponds to a sufficient size (e.g., ≥ 350 mm TL), or they may be large wild fish translocated from a wild population.
- **Use Fish From Near-by Populations**. Panelists strongly recommended the use of fish from either the Lake Mead population of razorback suckers or from the Colorado River below Davis Dam, near Laughlin, Nevada. They felt that these fish were genetically diverse and similar to the Lake Mead fish, with behavioral traits that would enhance their chances of survival in the lower Grand Canyon.
- **Release Adults Just Prior to Spawning**. Lake Mead biologists are using the strategy of releasing wild sonic-tagged adults into areas with suitable spawning habitat just prior to spawning. Tracking these fish and sampling the occupied areas show that these adults will congregate with other wild spawning adults and possibly engage in spawning. Adults near spawning condition released in deep pools near large alluvial cobble/gravel bars could produce young that would imprint to the site.
- **Release Fish as High Upstream as Possible**. Panelists believe that fish should be released as high upstream as possible in the lower Grand Canyon, upstream of Diamond Creek and preferably below Lava Falls rapid. This gives a greater chance for fish to remain in the lower Grand Canyon. Alternatively, fish released near Diamond Creek, Spencer Canyon, and Salt Creek would be near potential spawning bars and sufficiently high in the system to minimize escapement from the area.
- **Acclimate the Fish Before Release**. Panel members shared their experiences with releasing a variety of fish species into the wild, including razorback suckers, and expressed concern over the long-distance movements seen immediately after release. This "fright response" can be reduced by holding fish in live pens in the river prior to release; this allows the fish to acclimate and reduces their movement when released from the pens.
- **Conclusion**. The Science Panel felt that the best strategy is to release small numbers of wild-born adults that are river-conditioned and acclimated. The Panel also felt that fish should be released as far upstream as possible in the lower Grand Canyon (i.e., below Lava Falls rapid), or possibly at potential spawning sites at Diamond Creek, Spencer Canyon, and Salt Creek.

5. What can be done to link razorback suckers in the lower Grand Canyon and the Lake Mead inflow with the population currently in Lake Mead?

- **Determine if Lake Mead Fish are Already Using Lower Grand Canyon**. A comprehensive fish survey is needed of the lower Grand Canyon (Lava Falls rapid to Lake Mead inflow area) to determine if razorback suckers are already present in the area. Many fish from the Lake Mead population are PIT-tagged and some are sonic-tagged, and these fish would be easy to identify if found in the lower canyon.
- **Translocate Lake Mead Fish**. If introduction is deemed appropriate, the translocation of Lake Mead fish could provide the most direct linkage between the lower Grand Canyon and Lake Mead inflow. This may be done by translocating small numbers of wild adults; or fish that have been raised from wild-spawned larvae in riverside grow-out ponds. The fish should be raised in an environment that conditions them to velocity, cover, predators, and natural foods to maximize their survival.
- **Promote Expansion of Lake Mead Population**. Ongoing research on the Lake Mead population continues to provide a better understanding of the strategies of larvae and young razorback suckers in surviving the large numbers of predators in Lake Mead. High turbidity associated with inflows and shoreline vegetation and cobble appears to provide cover from predators for the young fish. These conditions exist in the Colorado River inflow to Lake Mead, and may be conducive to establishing a population that makes full use of available habitats in the lower Grand Canyon, as well as the Lake Mead inflow.
- **Conclusion**. Panel members reiterated that habitat in the lower Grand Canyon alone was marginal for the razorback sucker, primarily because of the absence of floodplains for nursing and rearing and the presence of only small numbers of ephemeral backwaters. The razorback sucker would most likely become established in the lower Grand Canyon as an extension of the Lake Mead population.

6. What are the most important issues that would need to be addressed or considered in establishing razorback suckers in the lower Grand Canyon and the Lake Mead inflow?

- **Do No Harm to Lake Mead Population**: The introduction of razorback suckers into the lower Grand Canyon should in no way compromise the demographic or genetic integrity of the Lake Mead population. Members of the Science Panel were adamant that any effort to introduce razorback suckers into the lower Grand Canyon should in no way compromise the Lake Mead population. They expressed concern over the introduction of particularly large numbers of razorback suckers from outside sources with unknown or limited genetic diversity, and recommended against the use of hatchery-reared fish from captive broodstock. These fish, if they survive in sufficient numbers, could potentially swamp the genetic uniqueness of the Lake Mead fish and negatively affect the inherited behavior and adaptive mechanisms that would lessen the chances of survival for the progeny. A preferred source of fish for stocking was identified as fish from the Lake Mead population or from the Colorado River below Davis Dam, although the numbers are small. Possibly wild larvae could be raised in protective ponds to a sufficient size and translocated into the lower Grand Canyon.

- **Establish Measures of Success**. Augmentation should be linked to the expectation of a defined measure of success. Success in establishing the species in the lower Grand Canyon should be measured as use of the area by subadults and adults for feeding and spawning and a linkage to the Lake Mead population. In all likelihood, establishment of the razorback sucker in the lower Grand Canyon will occur as an extension of the Lake Mead population. The numbers of adults and subadults that use the lower Grand Canyon may be low; possibly 100-200 fish; e.g., the 30 mi section of complex habitat might be expected to support fewer than 10 fish/mile.
- **Conclusion**. Care should be taken to ensure that any action to establish the razorback sucker in the lower Grand Canyon does not compromise the Lake Mead population. Establishing the species in the area may mean promoting an expansion of the existing Lake Mead population and success may be measured as use by the species as an extension of the Lake Mead population.

2.2 Issues of Consideration

As the Science Panel addressed the key and specific questions, several issues of consideration were identified. Individual panel members felt that these issues needed to be addressed—or at least discussed—as the key and specific questions were being addressed. The issues are the following:

1. **Is the goal of introducing fish into the lower Grand Canyon a biological question or a political issue?**

One panelist felt that the task given to the Science Panel presumed that razorback suckers would be introduced into an area that may not be entirely suitable to the species. Some panel members did not believe that it was a foregone conclusion that razorback suckers would inevitably be introduced into the lower Grand Canyon, particularly as political expediency to satisfy the conditions of a biological opinion. Members of the Panel agreed that the decision to introduce razorback suckers into the lower Grand Canyon should be based on the biological information, a rational evaluation of the likelihood of success, and on the contribution of the effort to the conservation of the species—and not simply on the need to satisfy the biological opinion.

2. **If the decision is made to introduce razorback suckers into the lower Grand Canyon, a strategy should be employed that will maximize survival of the introduced fish.**

Several panelists pointed out that traditional methods of hatchery culture and releases of large numbers of larval and juvenile razorback suckers into the wild have had little success. Survival of these fish has traditionally been low for a number of largely unknown reasons, but certainly predation by nonnative fishes is a principal factor. A strategy should be employed that uses the techniques that result in the highest possible survival rate for the fish and subsequent use of the area. One panelist strongly advocated the use of "conditioned fish" as part of a translocation strategy in which large razorback suckers are taken from an existing wild population, such as the Laughlin area below Davis Dam, or from the Lake Mead population. Using such fish would increase the chances of survival because individuals would be adapted to a riverine environment

and adept at finding habitat and food, as well as avoiding predators. The process for reaching a decision to augment the razorback sucker in the lower Grand Canyon is described in a strategy to establish the species developed as part of this deliberative process (Valdez et al. 2012b).

3. Introduction of razorback suckers could also introduce aquatic invasive species into the lower Grand Canyon and Lake Mead inflow.

Water used to transport fish from other systems could be carrying pathogens, diseases, or aquatic invasive species, such as crustaceans, mollusks, or fish that could negatively affect the ecosystem of the lower Grand Canyon and Lake Mead inflow. Quagga mussels are already abundant in Lake Mead below the inflow, and New Zealand mudsnails are common in the Lees Ferry reach below Glen Canyon Dam. However, other invasive species can be introduced, and the Science Panel urged care in transporting fish into the area. Panel members also pointed out that the interstate transport of fish requires State board inspections that may require sacrificing a sufficient number of fish for testing (e.g., 50). Such inspections may be required if fish are taken from Laughlin (Nevada) and transported for release at Diamond Creek (Arizona). Because of the small numbers of wild fish available, it may be necessary to develop alternative means for satisfying State board inspection requirements.

4. Nonnative fish predators are abundant in the Lake Mead inflow and will likely limit survival of young razorback suckers.

Nonnative fish predators are known to suppress the survival of young razorback suckers. Some members of the Science Panel strongly believe that young razorback suckers must be reared in predator-free environments to ensure adequate survival; however, any form of nonnative fish control or removal in the lower Grand Canyon and Lake Mead inflow is impractical. Panel members strongly recommend the use of large fish for initial releases, though the young fish would still be subject to substantial predation risk. Recent investigations of the Lake Mead population show that survival and recruitment of young naturally-spawned razorback suckers is made possible by the turbidity of the inflow and the presence of shoreline vegetation and cobble that provide cover from predators.

5. Razorback suckers may already be present in the lower Grand Canyon or individuals from the Lake Mead population may be using the area intermittently.

The lower Grand Canyon from Diamond Creek to Pearce Ferry was sampled intensively for fish during 1992–1995 and 2004-2006. Periodic sampling efforts were made by the Arizona Game and Fish Department (AGFD) and the Grand Canyon Monitoring and Research Center (GCMRC) in 2007–2008 as a pilot study to investigate channel catfish capture methods and to identify the extent of invasion by channel catfish into the Grand Canyon. Razorback suckers have not been caught or sighted during any of these sampling efforts. However, there have been dramatic habitat changes in this reach of the Colorado River since the level of Lake Mead began lowering in the year 2000 and much of the inflow delta is exposed. Members of the Science Panel each have experience in sampling razorback suckers and recognize the elusiveness of the species, and the possibility that small numbers of individuals are present in the lower Grand Canyon. Panel members agreed that a first step in this evaluation process should be a more thorough fish community sampling effort.

6. Lower Grand Canyon and Lake Mead inflow will likely continue to change physically, chemically, and biologically with dam releases and changing lake levels.

The habitat in the lower Grand Canyon and Lake Mead inflow (primarily from about Spencer Canyon [RM 246] to below Pearce Ferry [RM 280] is in a transitional stage as the Colorado River continues to carve a channel into the newly exposed deltaic deposits. This dynamic habitat condition is likely to continue for a number of years, depending on Lake Mead water levels, the stability of the newly formed river channel, and the ongoing effect of climate change on the hydrology of the Colorado River System. The effect of this dynamic nature inflow on the razorback sucker is unknown, but although the habitat appears unstable, the erosion of enriched deltaic deposits could contribute substantially to the food base and the instability may favor native species over less adaptable nonnative fishes. As evidence of the dynamic nature of the inflow channel, a severe rapid that formed about 1 mi downstream of Pearce Ferry in 2010 impeded the movement of sonic-tagged razorback suckers in 2010, but by 2011 the channel had continued to change, allowing the upstream movement of fish.

7. Maintain ongoing coordination with stakeholders and interested parties.

Any plans to introduce razorback suckers into the lower Grand Canyon should continue to be coordinated by Reclamation with stakeholders and interested parties. Reclamation has committed to undertake this investigation in collaboration with the U.S. Fish and Wildlife Service and in coordination with Glen Canyon Dam Adaptive Management Program, Lower Colorado River Multi-Species Conservation Program, National Park Service, Grand Canyon Monitoring and Research Center, Nevada Department of Wildlife, Arizona Game and Fish Department, and the Hualapai Tribe. Coordination should also be maintained with the Lake Mead Razorback Sucker Work Group and Bio/West, the contractor conducting investigations of the razorback sucker in Lake Mead.

3.0 SUMMARY

The following is a summary of the Science Panel for the potential of habitat for the razorback sucker in the lower Grand Canyon and Colorado River inflow to Lake Mead:

1. **Support efforts to better understand and promote the razorback sucker population in Lake Mead.**

The razorback sucker population in Lake Mead is the largest reproducing and recruiting population in the Colorado River System. Efforts to conserve and expand this population should be promoted, and any actions to establish the species in the lower Grand Canyon should be done in a manner that complements those efforts and does not harm or compromise the Lake Mead population. The Science Panel views the lower Grand Canyon and Lake Mead inflow as a single contiguous ecological complex, and the most likely way in which razorback suckers could become established in the lower Grand Canyon is as an expansion of the Lake Mead population.

2. **Identify and assimilate the existing and historic information on the fish community, food base, and habitat of the lower Grand Canyon and Lake Mead inflow.**

Much of the literature and information on the lower Grand Canyon was assimilated in Report #1 on habitat of the razorback sucker. Information on the species and from the area should be kept current and ongoing involvement and participation should be maintained with the Lake Mead Razorback Sucker Work Group. The fish community of the lower Grand Canyon should be surveyed and habitat should be determined from sonic-tagged razorback suckers. An expansive habitat assessment (e.g., PHABSIM) is not recommended, nor is an expansive food base study. The food base should be quantified as the macroinvertebrate densities and diversity in primary habitats, including cobbles, deposits, talus, and woody debris.

3. **Initiate fish community surveys of the Lower Grand Canyon (Lava Falls rapid to Lake Mead inflow) and determine if razorback suckers are present.**

Fish surveys should be conducted from Lava Falls rapid to the Lake Mead inflow to document the fish community in this reach of the Colorado River. Intensive fish surveys have not been conducted in this area since 1995, and large changes to the Lake Mead inflow from a declining reservoir elevation have changed the habitat and likely the fish community. A larval fish survey could/should serve as the initial sampling effort to identify all spawning fish in the system, including razorback suckers that may have gone undetected. The inflow has not stabilized because the river continues to carve a channel in the deltaic deposits and fish habitat and populations may continue to change. As these surveys are being conducted small numbers of large sonic-tagged razorback suckers should be released to determine: (a) if the fish will remain in the area, (b) their movement and habitat use, and (c) to help locate other razorback suckers in the area (as Judas fish). Wild fish should be used, such as large individuals from the population below Davis Dam or from Lake Mead. About 10–15 fish should be released as far upstream as possible in the lower Grand Canyon, or in pools adjacent to large cobble/gravel bars at Diamond Creek, Spencer Canyon, and Salt Creek. Field crews conducting fish surveys can simultaneously sample fish and monitor the sonic-tagged fish. Sampling should before and after spawning (February-May) and larvae should be sampled thereafter.

4. Evaluate lower Grand Canyon/Lake Mead inflow in a basin-wide perspective of razorback sucker conservation.

The Razorback Sucker Recovery Goals call for two self-sustained populations each in the lower and upper Colorado River basins. These recovery goals do not specify where these populations should be established. Biologists and managers should identify and describe areas that provide the greatest potential for conservation of the species. The Lake Mead population has been recognized as the largest self-sustaining population and an expansion of the population is desirable. The lower Grand Canyon may have a role in that expansion, but biologists and managers should proceed cautiously so as not to compromise the Lake Mead population in attempting to establish razorback suckers in lower Grand Canyon. A long-term definition of success may simply be establishing the presence of fish in the lower Grand Canyon as an extension of the Lake Mead population.

5. If augmentation is deemed appropriate, use translocated wild fish.

Augmentation of the razorback sucker into the lower Grand Canyon should proceed with caution so as not to swamp the genetic diversity of the wild Lake Mead population. The need for augmentation should be determined following fish community surveys of the lower Grand Canyon and Lake Mead inflow. Augmentation, if deemed appropriate, should involve small numbers of large fish from near-by populations. Large fish may be taken from the Lake Mead population or from the lower Colorado River below Davis Dam. Alternatively, wild larvae may be captured and raised in grow-out ponds such as isolated lakeside coves. This will help to condition the fish to natural foods and habitat. The fish should be stocked at a sufficient size to minimize predation and enhance survival ($\geq$ 350 mm TL), based on findings in the lower and upper basins. Large numbers of small hatchery-reared fish should not be used.

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APPENDIX A: Science Panel Titles and Publications

Chuck McAda

Present Position: Project Leader, Colorado River Fishery Project; U.S. Fish and Wildlife Service, Grand Junction, CO (retired)

Relevant Reports and Publications:

McAda, C.W., J.W. Williams, J.S. Cranney, T.E. Chart, W.R. Elmblad, and T.P. Nesler. 1994. Interagency standardized monitoring program: summary of results, 1986–1992. U.S. Fish and Wildlife Service, Grand Junction, CO.

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McAda, C.W. 2003. Flow recommendations to benefit endangered fishes in the Colorado and Gunnison rivers. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

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Gordon A. Mueller

Present Position: U.S. Geological Survey, Denver, CO (retired).

Relevant Reports and Publications:

Mueller, G., and D.K. Foster. 1999. A case for site acclimation in the reintroduction of the endangered razorback sucker (*Xyrauchen texanus*). U.S. Geological Survey Open-File Report 99-110, MESC, Denver Field Office, CO.

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Mueller, G.A., P.C. Marsh, D. Foster, M. Ulibarri and T. Burke. 2003. Factors influencing post-stocking dispersal of razorback sucker. North American Journal of Fisheries Management 23(1): 270–275.

Mueller, G.A. 2006. Ecology of bonytail and razorback sucker and the role of off-channel habitats in their recovery. U.S. Geological Survey Investigations Report 2006-5-65.

Dale W. Ryden:

Present Position: Project Leader, Colorado River Fishery Project; U.S. Fish and Wildlife Service, Grand Junction, CO.

Relevant Reports and Publications:

Ryden, D.W. 1997. Five-year augmentation plan for razorback sucker in the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.

Ryden, D.W. 2000. Monitoring of experimentally stocked razorback sucker in the San Juan River: March 1994 through October 1997. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

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Crist, L.W. and D.W. Ryden. 2003. Genetics management plan for the endangered fishes of the San Juan River. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Melissa Trammell

Present Position: Fisheries Biologist, National Park Service, Salt Lake City, UT.

Relevant Reports and Publications:

Trammell, M., R.A. Valdez, S. Carothers, and R. Ryel. 2001. Effects of a low steady summer flow experiment on native fishes of the Colorado River in Grand Canyon, Arizona. Report of SWCA, Inc., Flagstaff, Arizona, to Grand Canyon Monitoring and Research Center, Flagstaff, AZ.

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Richard Valdez, Ph.D.

Present Position: Senior Aquatic Ecologist, SWCA, Environmental Consultants, Logan, UT.

Relevant Reports and Publications:

Valdez R., T. Chart, T. Nesler, D. Speas, and M. Trammell. 2008. Yampa River nonnative fish control strategy. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

Valdez, R.A. (Chairman), T. Chart, G. Burton, D. Irving, K. LaGory, R. Muth, H. Patno, and D Speas. 2006. Study plan for the implementation and evaluation of flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. U.S. Fish and Wildlife Service, Region 6; Bureau of Reclamation, Upper Colorado Region; Western Area Power Administration, Salt Lake City, UT.

Valdez, R.A. and R.T. Muth. 2005. Ecology and conservation of native fishes in the Upper Colorado River Basin, in J.N. Rinne, R.M. Hughes, and B. Calamusso (eds). Historical changes in large river fish assemblages of the Americas. American Fisheries Society, Bethesda, MD.

Valdez, R.A. and P. Nelson. 2004. Green River Floodplain Management Plan. Upper Colorado River Endangered Fish Recovery Program, Project No. C-6, Denver, CO.

Webb, R.H., J.C. Schmidt, G.R. Marzolf, and R.A. Valdez (eds.). 1999. The Controlled Flood in Grand Canyon. Geophysical Monograph 110, American Geophysical Union, Washington, D.C.

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The Potential of Habitat for the Razorback Sucker in the Lower Grand Canyon

Richard Valdez
SWCA
and
Mark McKinstry
U.S. Bureau of Reclamation

Razorback Sucker
(Xyrauchen texanus)

Outline

- History of RBS in BiOps.
- RBS in Grand Canyon.
- Habitat of Lower GC and Lake Mead Inflow.
- Significance of LGC – LMI linkage.
- Recommendations.

1995 BiOp (Reclamation, Operation of Glen Canyon Dam)—

"…sponsoring a workshop…of species experts…to develop a management plan for the species in the Grand Canyon."

Workshop: Jan 11-12, 1996 – Laughlin, NV
(72 attended)

- ***Dr. Harold Tyus (UC): Floodplains, nonnative fish, altered hydrograph.***
- ***Dr. Paul Marsh (ASU): Predatory nonnative fish.***
- ***Dr. Tom Dowling (ASU): Historical genetic exchange has led to a single population.***
- ***Dr. Rich Valdez (B/W): Floodplains, cold water, nonnative fish; 10 RBS (1944-96).***
- ***Mike Yard (GCES): Lower reach (RM 240-280) variable, not geomorphologically constrained, Lake Mead elevation.***

2006 BiOp (NPS-Colorado River Management Plan)—

"…conduct surveys of backwaters and side channels in the Lower Gorge-Lake Mead interface, and that portion of LAME where project activities extend, for spawning razorback suckers…"

Fish Sampling Diamond Creek to Pearce Ferry

- ***June 1992 – January 1994 (Valdez 1994; Valdez et al. 1995).***
- ***June – October 1997 (Hualapai Tribe & SWCA; 15 rt RBS).***
- ***2004 – 2006 (Ackerman et al. 2006; Ackerman 2007).***
- ***2005 (Rogers et al. 2007).***
- ***May 2009 (Speas and Trammell 2009).***
- ***2010 – 2012 (GCMRC, EL)—1 RBS at Surprise (10/7/2012).***

2007 BiOp (Reclamation, Shortages and Coordinated Reservoir Operations)— *"…examine the potential of habitat in the lower Grand Canyon for the species, and institute an augmentation program in collaboration with FWS, if appropriate."*

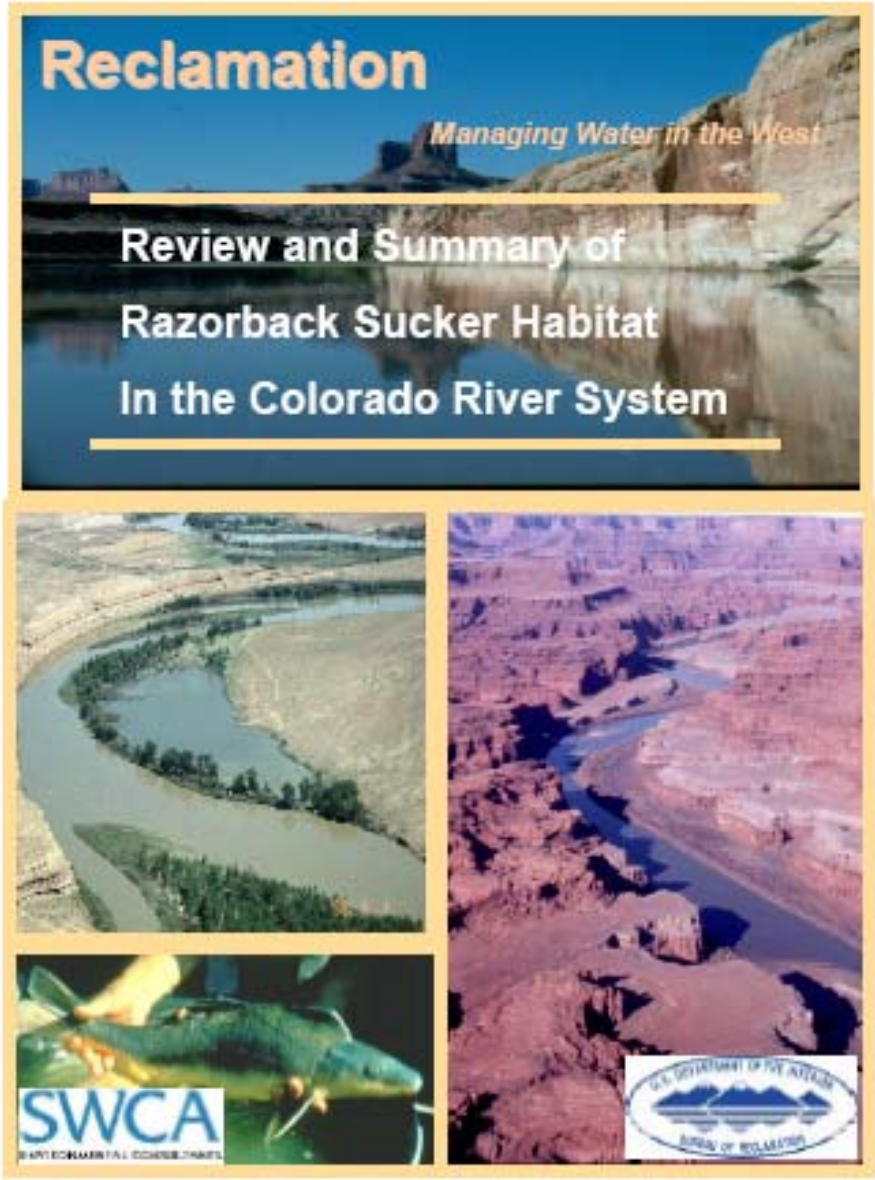
- ***Recon Trip of Cooperators: Reclamation, USFWS, GCDAMP, MSCP, NPS, GCMRC, NDOW, AGFD, Hualapai Tribe (Sept 2010).***
- ***Science Panel (5 species experts)***
- ***Three Reports***

Report #1:

Review and Summary of Razorback Sucker Habitat in the Colorado River System

- Spawning, incubation, larval drift, nurseries, movement, diet, subadult and adult habitat.

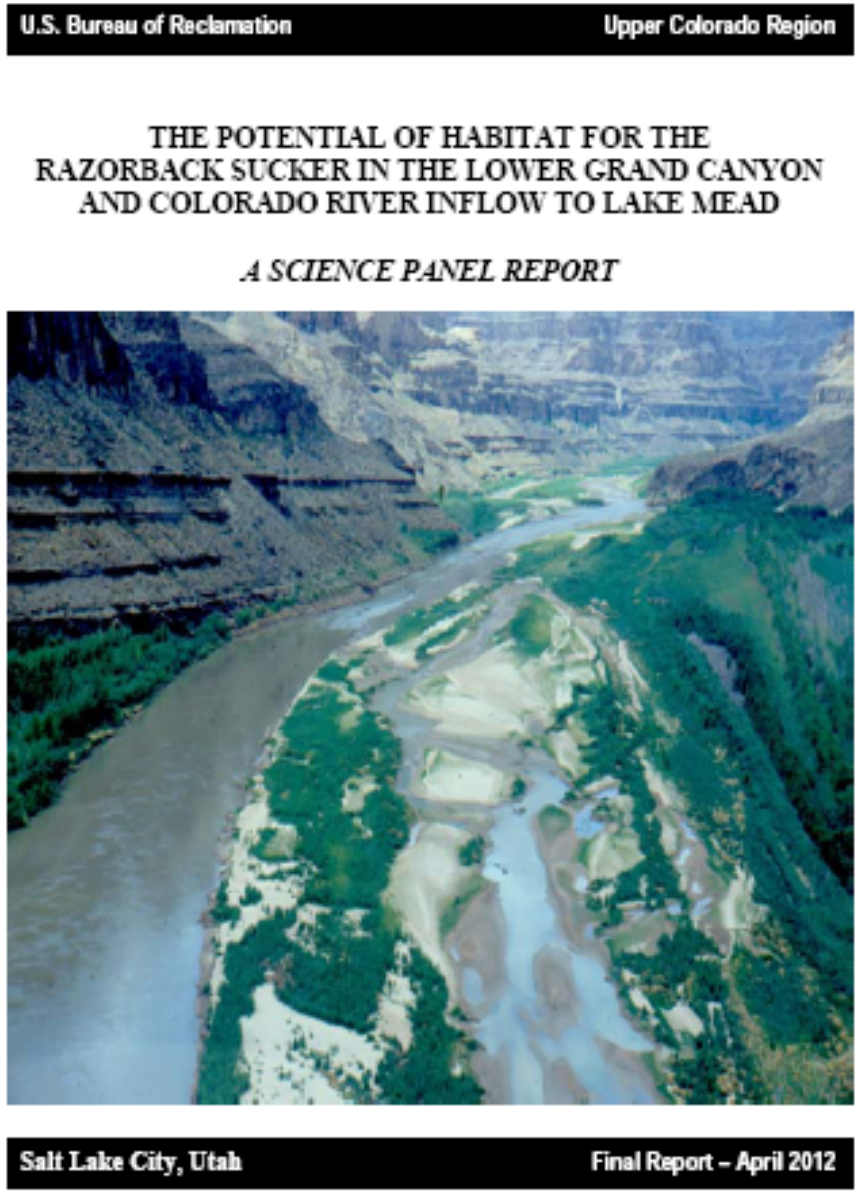
- Used to gauge suitability of lower Grand Canyon and Colorado River inflow.



Report #2: Science Panel

The Potential of Habitat for the Razorback Sucker in the Lower Grand Canyon and Colorado River Inflow to Lake Mead

- Views, opinions, and recommendations of a Panel of species experts.
- Developed from recon field trip and meetings of Panel in September, 2010.



Report #3:

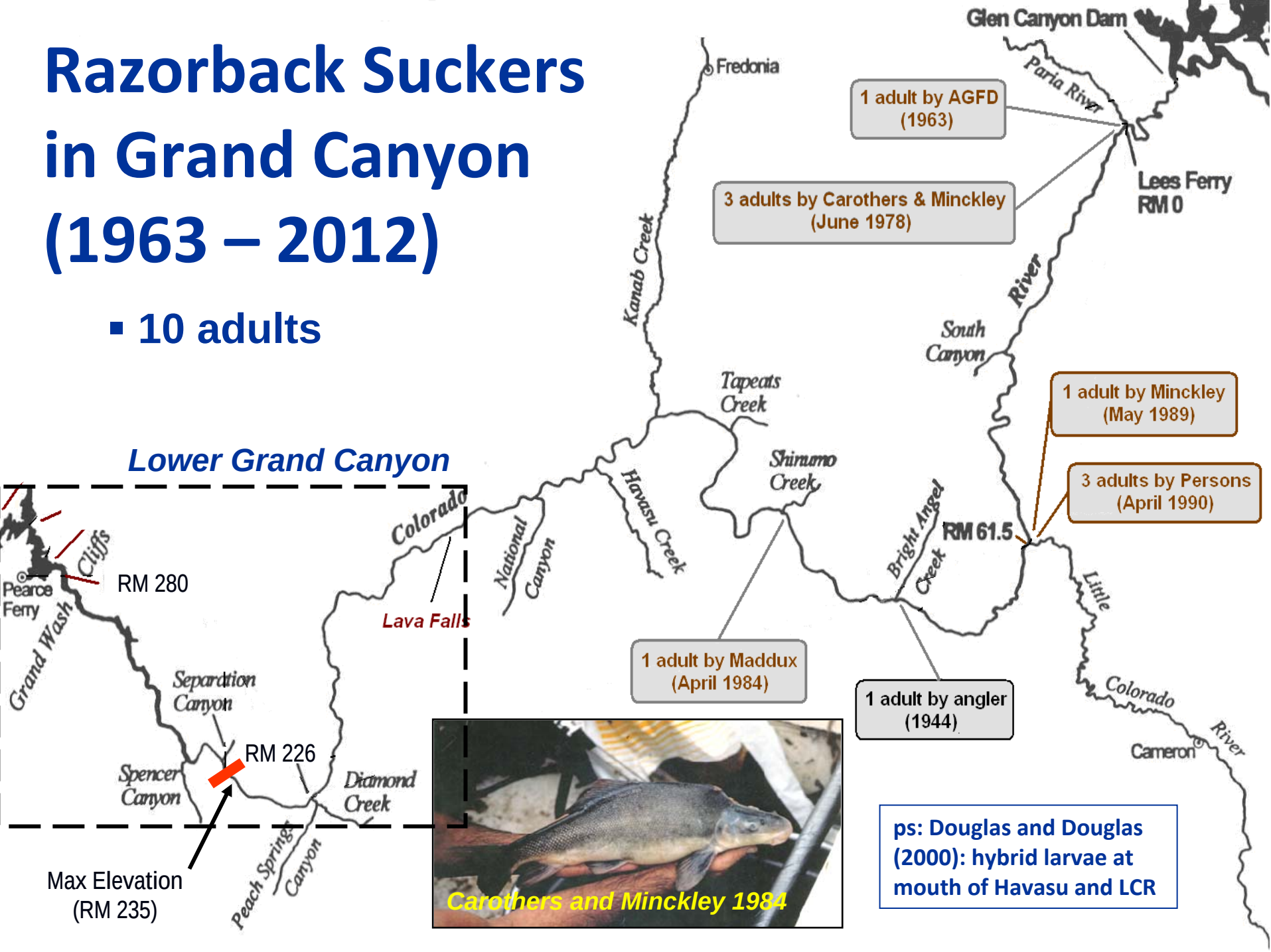
Strategy for Establishing the Razorback Sucker in the Lower Grand Canyon and Lake Mead Inflow

- Strategy for establishment of the RBS in lower Grand Canyon.

- Naturally through expansion of the Lake Mead population or possibly through augmentation.

Razorback Suckers in Grand Canyon (1963 – 2012)

- 10 adults



ps: Douglas and Douglas (2000): hybrid larvae at mouth of Havasu and LCR

Why No RBS in Grand Canyon?

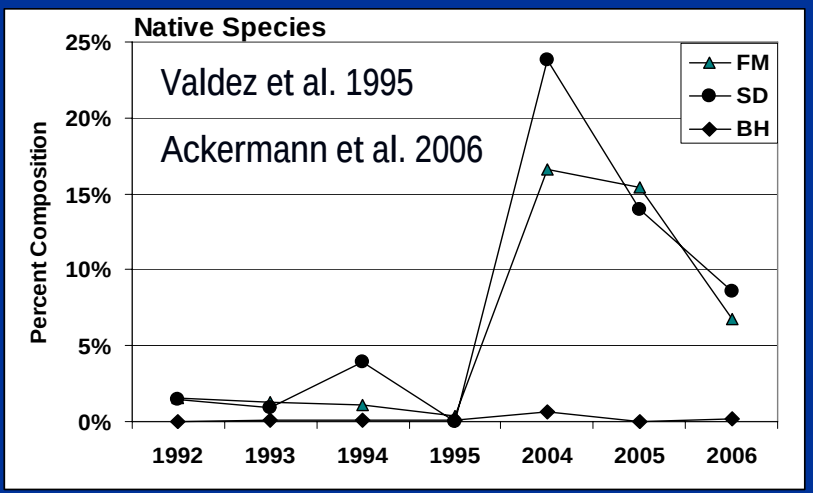
Much of the Grand Canyon looks like this !

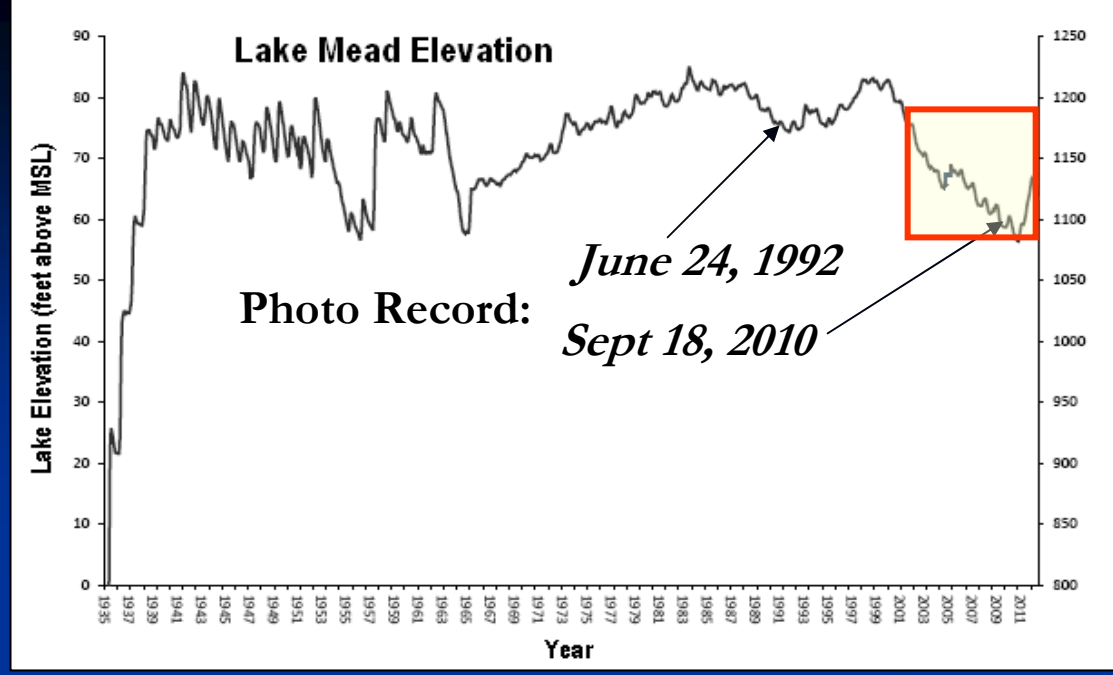
No Floodplains for 300 miles

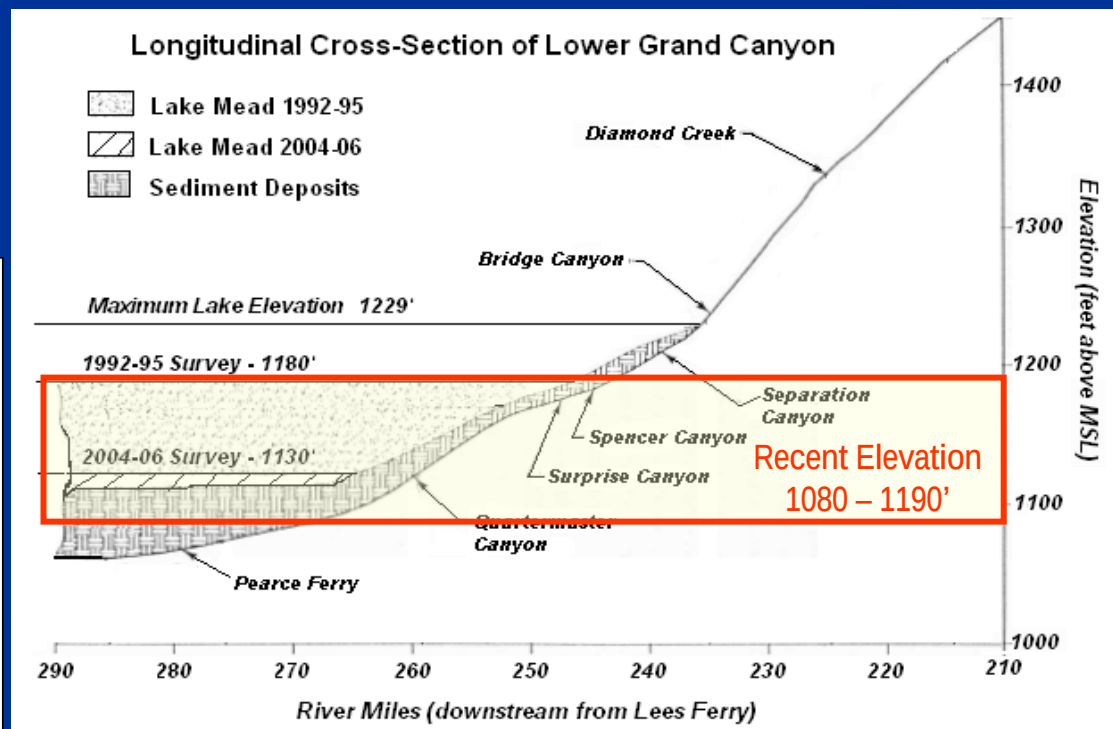
Most RBS have been found near tributary inflows

Will RBS Continue to Use the LMI?

- RBS larvae found in LMI in 2000-2001
- RBS adults and larvae found starting in 2010
- RBS found in LMI when lake elevation declined
- Numbers of native suckers increased in ~2004







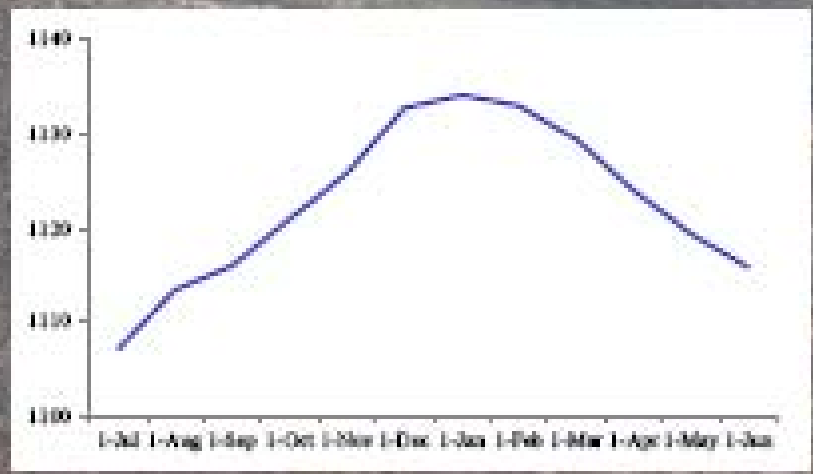
June 24, 1992 (Valdez)

June 24, 1992 (Valdez)

September 18-19, 2010 (McAda)

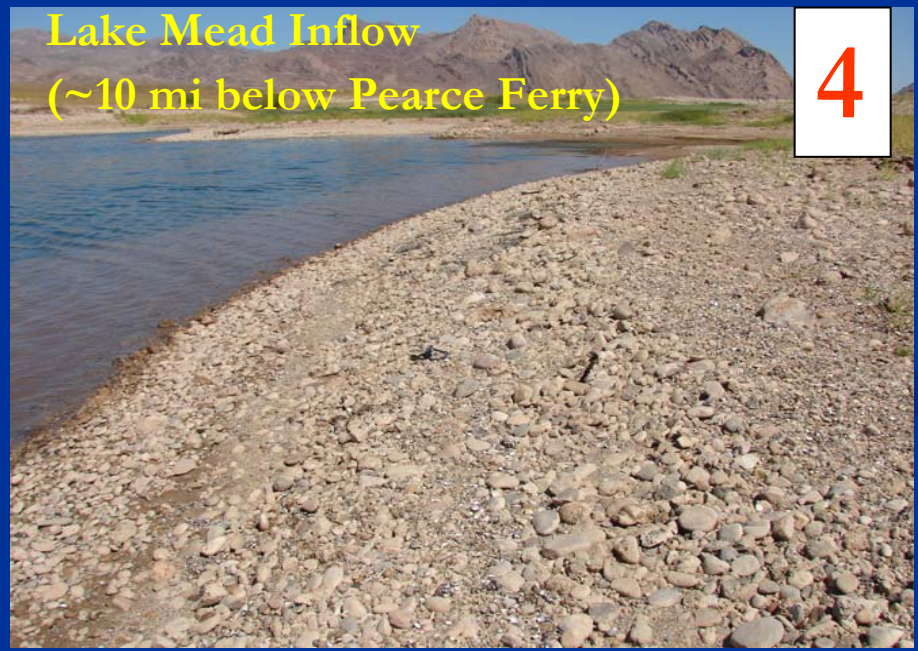
Pearce Ferry Rapid

March 2012



Slide from Kegerries and Albrecht 2012

September 18-19, 2010 (McAda)



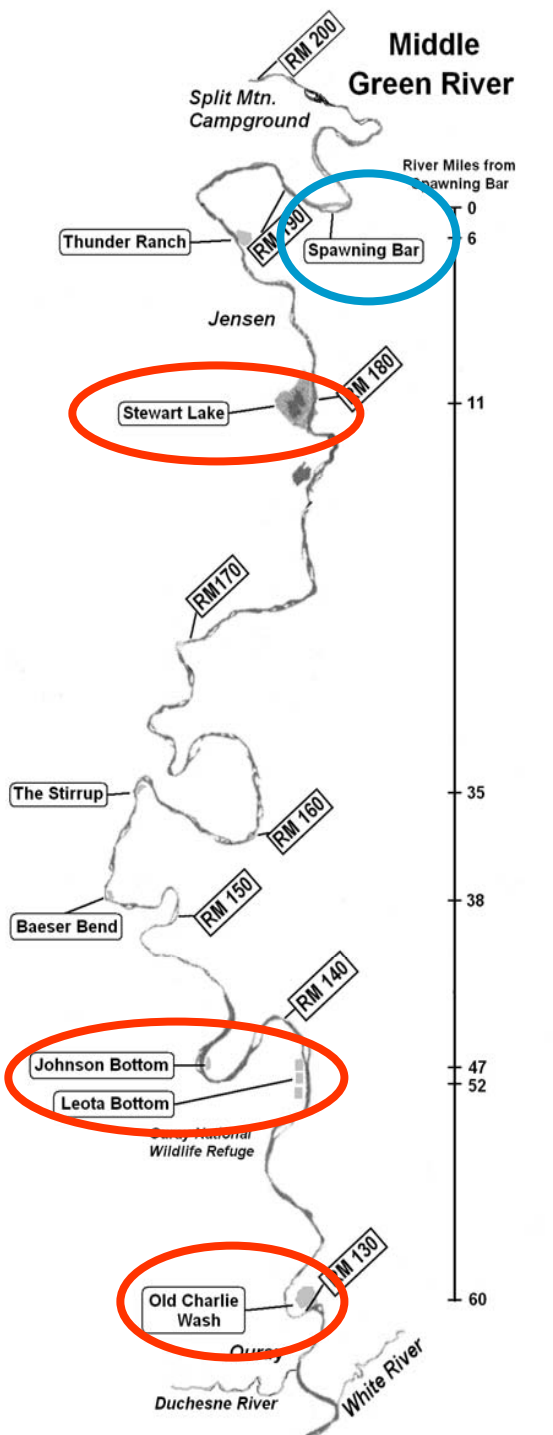
Nursery Habitat for RBS

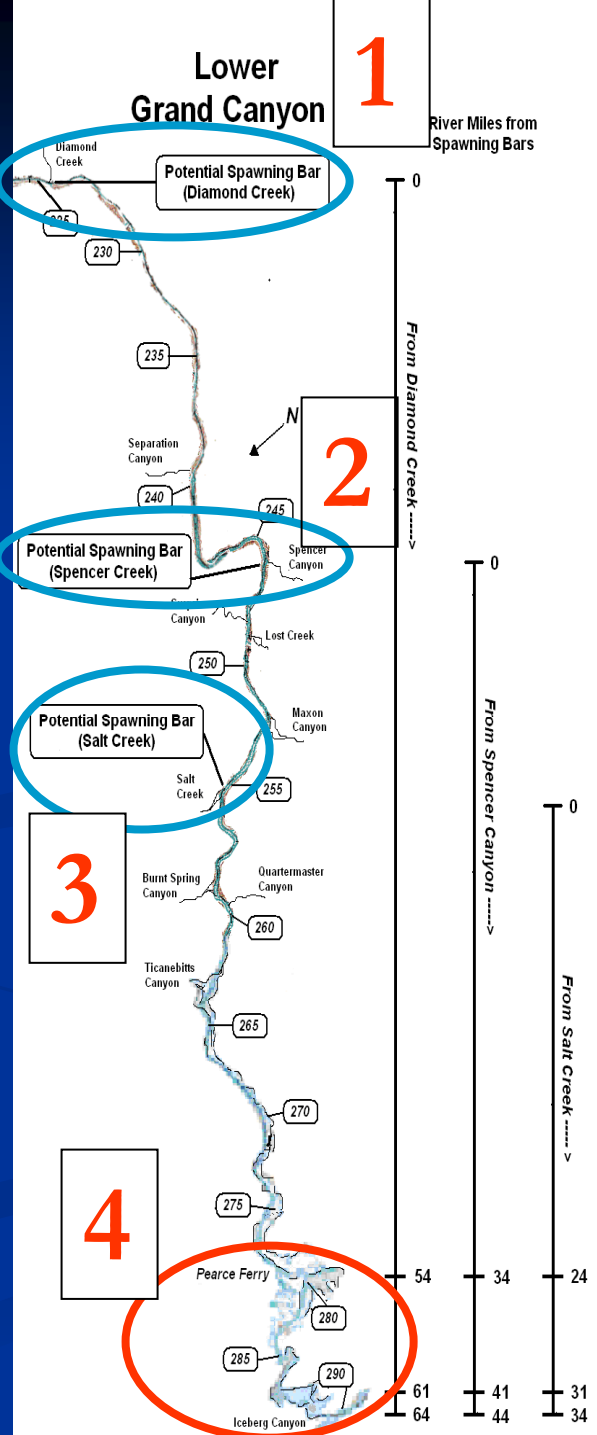
1 Spawn Bar to Floodplains:

- Old Charlie Wash – 60 mi
- Leota Bottom – 52 mi
- Stewart Lake – 11 mi

3 Bars to Pearce Ferry Bay:

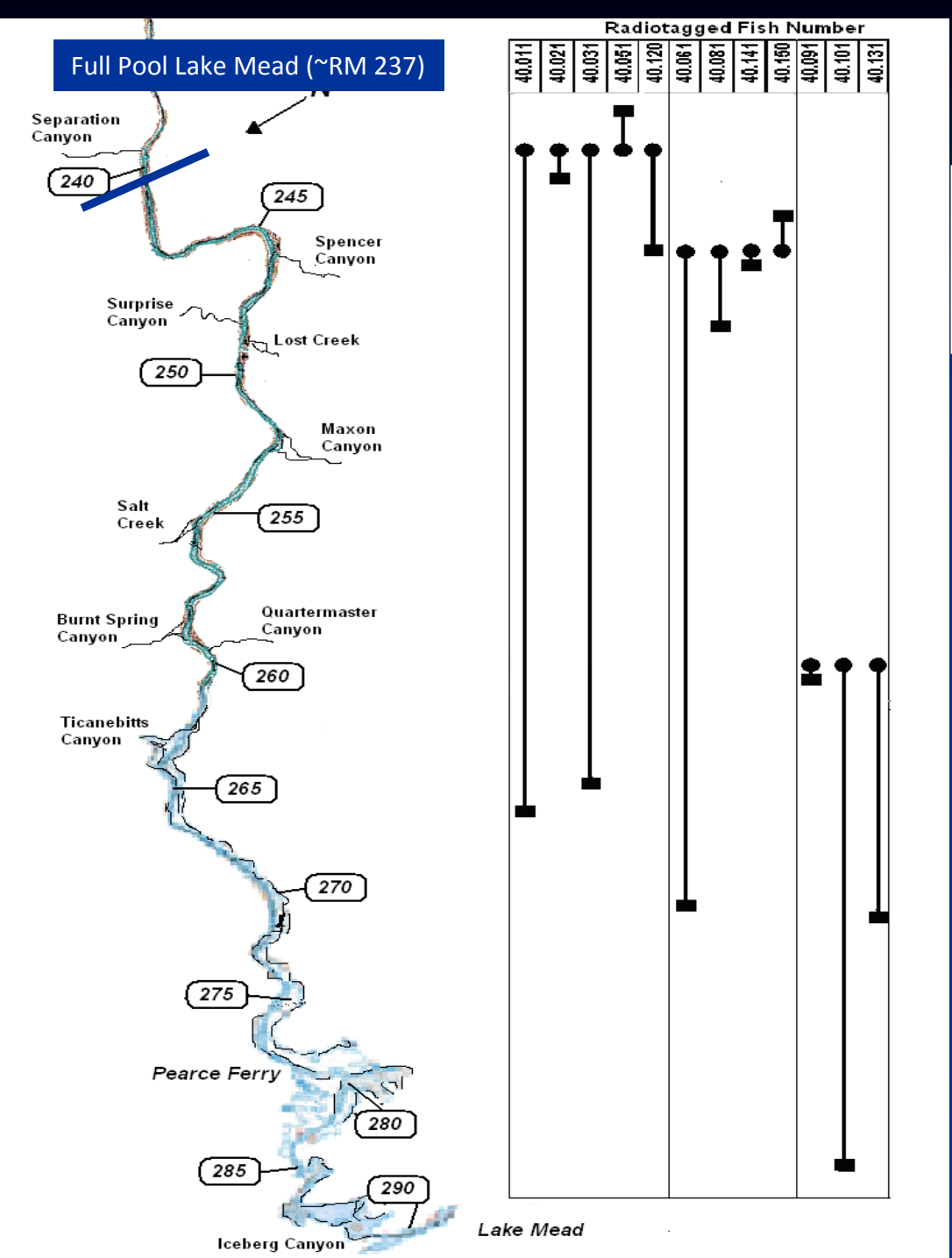
- Diamond Creek – 54 mi
- Spencer Canyon – 34 mi
- Salt Canyon – 24 mi





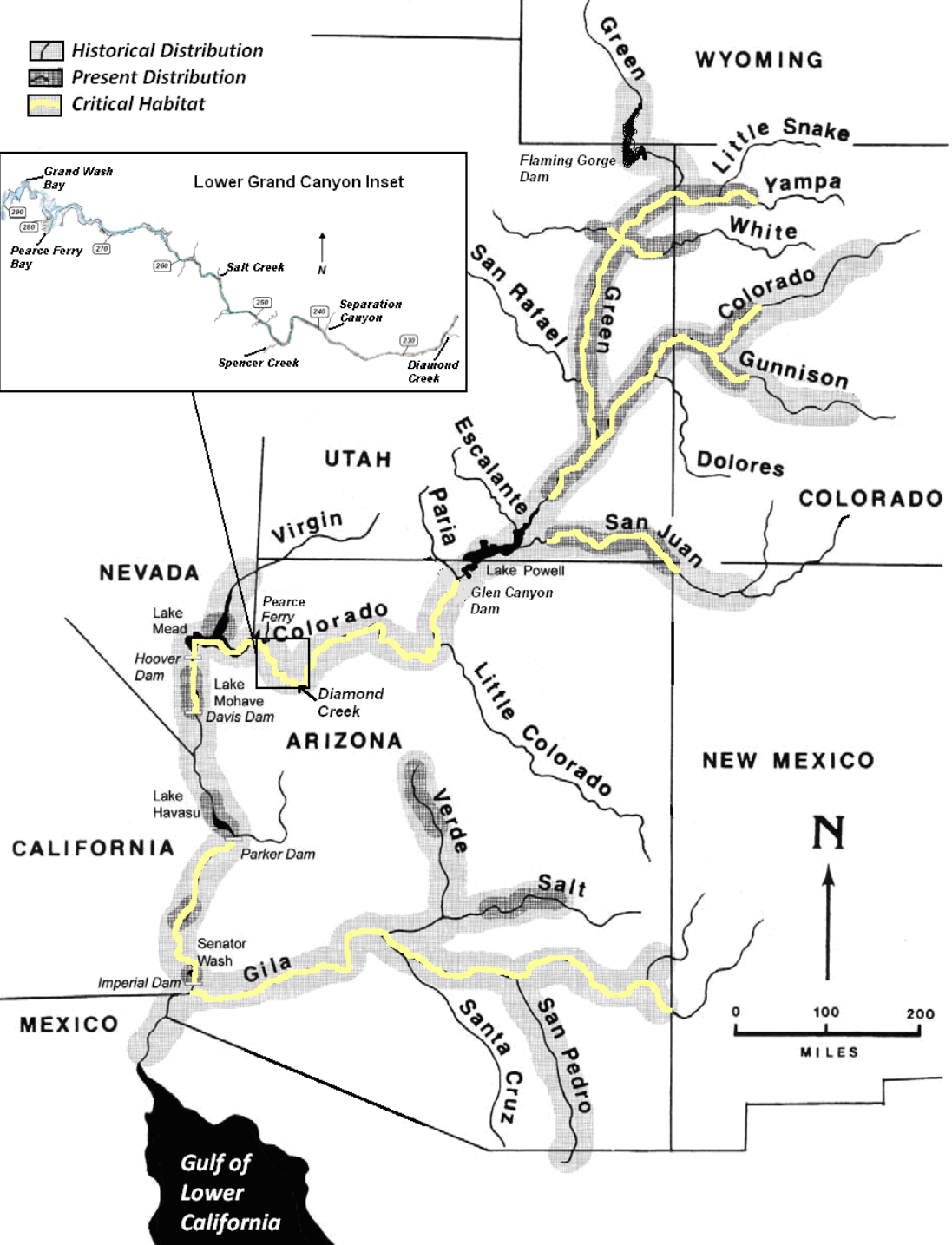
Hualapai sonic tagging study 1997

Movements of 12 Radio-tagged Adults, Jun-Oct 1997(Date Courtesy SWCA)



- 12 fish at 3 locations
- 15 weeks of tracking, 48 contacts
- 2 moved upstream 10 downstream
- 60% of locations eddies or lake

- **6 fish remained between Separation and Surprise in what was the interface zone of river and lake in 1997**
- **6 fish moved into what was the lake area in 1997**



Significance

- RBS Population in Lake Mead is largest known with reproduction, recruitment.
- 3 metapops in Lake Mead with fish mixing.
- 4th metapop in LM Inflow.
- RBS from LMI found in Lower Grand Canyon.
- Untagged RBS 500+ mm caught ~Oct 6, 2012 at Spencer.
- Lower Grand Canyon may be important to Lake Mead pop.

Recommendations

- Phase I: Determine the presence of and use by razorback suckers in the lower Grand Canyon;
- Phase II: Assess and evaluate the viability of the Lake Mead razorback sucker population and its linkage to the lower Grand Canyon; and
- Phase III: Determine the appropriateness of an augmentation program for the razorback sucker in the lower Grand Canyon.