

RECLAMATION

Managing Water in the West

Three-Year Review of Razorback Sucker *Xyrauchen texanus* Research in Grand Canyon and Colorado River Inflow to Lake Mead

A Science Panel Report



U.S. Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

Cover Photo:

At approximately RM 250 in the Grand Canyon, biologists Ron Kegerries and Mark McKinstry catch native species during a particularly muddy seine haul. Photo by Harrison Mohn.

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1.0 INTRODUCTION

1.1 Background

Since the mid-1990s, the Razorback Sucker *Xyrauchen texanus* was considered extirpated from the Grand Canyon (NPS 2017). In 2010 the U.S. Bureau of Reclamation, Upper Colorado Region (Reclamation), and the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) initiated a joint project to evaluate Razorback Sucker use of the Colorado River Inflow Area of Lake Mead. This project stemmed from over a decade of work in other areas of Lake Mead, during which biologists found and monitored a wild, self-propagating population of fish. Initial surveys at the Colorado River Inflow Area of Lake Mead showed that Razorback Suckers were also spawning and recruiting there, and the species could be found in the lower few miles of river. Lake Mead and the Colorado River Inflow Area of Lake Mead remain the only documented locations in the Colorado River basin where Razorback Suckers are naturally spawning and recruiting, and doing so in the absence of a stocking program (Albrecht et al. 2010; Kegerries and Albrecht 2013). The project at the Colorado River Inflow Area of Lake Mead was based on a Biological Opinion (BiOp) from the U.S. Fish and Wildlife Service (USFWS) which recommended that Reclamation begin a project to “. . . examine the potential habitat in the lower Grand Canyon (Lava Falls downstream and including the inflow portion of Lake Mead) for the species, and institute an augmentation program in collaboration with USFWS, if appropriate” (USFWS 2007).

In 2012, Dr. Mark McKinstry (Reclamation) convened an independent scientific review panel (Science Panel) of experts on Razorback Sucker ecology and biology. Dr. Richard Valdez, under contract with Reclamation, served as the chair for the panel. The original panel members included Chuck McAda, Gordon Mueller, Dale Ryden, Melissa Trammell, and Dr. Richard Valdez. Three documents were completed related to pursuing the conservation measure from the 2007 BiOp:

- 1) Report Number 1 – A review and summary of Razorback Sucker habitat in the Colorado River system (Valdez et al. 2012a).
- 2) 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 (Valdez et al. 2012b).
- 3) Report Number 3 – Strategy for establishing the Razorback Sucker in the lower Grand Canyon and Lake Mead inflow (Valdez et al. 2012c).

On January 26, 2017, a follow-up Science Panel was convened by Dr. Mark McKinstry (Reclamation) to assess the results of research recommended by the original Science Panel and conducted during the last 3 years (as recommended in the 2012 Science Panel Report, section

1.2) within the Colorado River Inflow Area of Lake Mead and in the Grand Canyon. This Science Panel consisted of Thomas Chart (USFWS), Matthew Chmiel (Arizona Game and Fish Department), Dr. David Propst (University of New Mexico), Dale Ryden (USFWS), Brandon Senger (Nevada Department of Wildlife), Melissa Trammel (U.S. National Park Service [NPS]), Dr. Thomas Turner (University of New Mexico), and Dr. Richard Valdez (SWCA). Morning presentations were opened by Dr. Mark McKinstry, Reclamation, who presented the past BiOps that led to the 2012 science review (USFWS 1995; USFWS 2005; USFWS 2007) and thanked all of those past and present who contributed to Razorback Sucker work pursuant to the BiOps and the past panel reports. Brian Healy from the NPS, Grand Canyon, also presented insights from the last 3 years and discussed how the ongoing study fits within the overall Fisheries Management Plan (NPS 2013). Brandon Albrecht of BIO-WEST, Inc. (BIO-WEST) informed the group on work occurring in Lake Mead and long-term sampling taking place at several different inflow areas, some of which have been sampled for the last 20 years (Kegerries et al. 2016a, 2016b; Mohn et al. 2016). Steven Platania of American Southwest Ichthyological Researchers (ASIR) presented the generalized random tessellation stratified sampling design used to randomly sample the lower Grand Canyon (LGC; Kegerries et al. 2016a). Ron Kegerries of BIO-WEST then updated the group about the ongoing efforts within the LGC, including the last 3 years (2014–2016) of small-bodied fish sampling data, which consisted of all fish captured in seines that could be identified easily in the field (Kegerries et al. 2016a). Eliza Gilbert of ASIR presented Razorback Sucker larvae data collected during the same 3-year period of small-bodied fish sampling in the LGC to inform the panelists of the regularity at which Razorback Sucker larvae are captured in the study area. After presenting the research results, the Science Panel was given the opportunity to express thoughts, concerns, and recommendations on the current research. Additionally, the panel highlighted areas of research that should be considered in the future in relation to Razorback Sucker in the Grand Canyon and Colorado River Inflow Area of Lake Mead, which is covered in section 2.0.

1.2 Summary of Original Recommendations Made by the 2012 Science Panel

The following section is a summary of recommendations drawn from the 2012 Science Panel and is intended to provide context to this document. Along with each numbered recommendation, the reasoning behind each is provided. For a more detailed view of the work completed by the 2012 Science Panel, please refer to Valdez et al. (2012a, 2012b, 2012c). The 2017 Science Panel's discussion of these topics can be found in section 2.0.

- 1) *Continue ongoing work with Razorback Sucker at the Colorado River Inflow Area and throughout Lake Mead.*

The Razorback Sucker population in Lake Mead is the largest documented 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 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 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 Grand Canyon is by an expansion of the Lake Mead population. The Razorback Sucker recovery goals call for two self-sustaining populations each in the lower and upper Colorado River subbasins (USFWS 2002). 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 this population is desirable. The 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 additional Razorback Suckers in the Grand Canyon, as this expansion may be occurring naturally. A long-term definition of success may simply be establishing the presence of fish in the Grand Canyon as an extension of the Lake Mead population.

- 2) *Do not force augmentation (i.e., stocking) of Razorback Sucker. If stocking is done, use translocated, wild Razorback Suckers (or wild larvae from the Lake Mead population).*

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

- 3) *Integrate all information on fish and food base in the Grand Canyon and the Colorado River Inflow Area of Lake Mead.*

Much of the literature and information on the Grand Canyon was assimilated in Report #1 on habitat of the Razorback Sucker (Valdez et al. 2012a). 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 Grand Canyon should be surveyed and habitat use should be determined by tracking sonic-tagged Razorback Suckers. An expansive habitat assessment (e.g., Physical Habitat Simulation [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, nursery habitats, and woody debris.

- 4) *Expand fish surveys, especially for Razorback Suckers, in Lower Grand Canyon and investigate larval fish to get evidence of spawning and use of river.*

Fish surveys should be conducted from Lava Falls Rapid (RM 180) to the Lake Mead Inflow Area 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 declining reservoir elevations in the Lake Mead Inflow Area 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 conducted, small numbers of large sonic-tagged Razorback Suckers should be released to: (a) determine whether the fish will remain in the area, (b) ascertain their movements and habitat use, and (c) 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 Grand Canyon or in pools adjacent to large cobble/gravel bars at Diamond Creek (RM 226), Spencer Canyon (RM 246), and Salt Creek (RM 256). Field crews conducting fish surveys can simultaneously sample fish and monitor the sonic-tagged fish. Sampling should be conducted before and after spawning (February–May), and larvae should be sampled thereafter.

1.3 Recent Research Summary

The summary below is not meant to be all-inclusive of the findings of the project during 2014–2016; therefore, the reader is encouraged to review Albrecht et al. (2014), Kegerries et al. (2015), and Kegerries et al. (2016a).

In 2014, Reclamation in cooperation with NPS–Grand Canyon and the contractors BIO-WEST and ASIR, began a project to further document Razorback Sucker use of LGC (i.e., downstream of Lava Falls Rapid). Consistent with the 2012 Science Panel recommendations, nine sonic-tagged, adult Razorback Suckers were released at Lava Falls with the goal that they would lead to concentrations (e.g., spawning areas) of other Razorback Suckers. A project was also started to randomly sample the small-bodied and larval fish community and track sonic-tagged adults.

Over 40 sites were sampled during larval and small-fish surveys from Lava Falls Rapid downstream to Pearce Ferry, a distance of 100 river miles (RM 179–280). River miles in this section of river are measured beginning at Lee’s Ferry (RM 0). Subsequent sampling during seven trips in each 2014 and 2015 documented Razorback Suckers spawning and larvae throughout the sampling area, indicating that Razorback Suckers were using the area and spawning from late February until June. Due to these findings, in 2016 the sampling area was extended approximately 100 miles upstream to Bright Angel Creek (approximately RM 88) in an attempt to identify the upstream extent of spawning. Larval Razorback Suckers were detected in

2016, upstream of Lava Falls and as far upstream as Havasu Creek (approximately RM 157), indicating that spawning occurs somewhere above this point (Kegerries et al. 2016a). Telemetry results suggest that the area near Spencer Creek (just below RM 246) is a possible spawning location; telemetry has also helped biologists locate important year-round areas for Razorback Sucker and document extensive movements throughout the Grand Canyon (Kegerries et al. 2016a).

Sampling efforts have also identified extensive spawning by Humpback Chub *Gila cypha* and other native suckers including Flannelmouth Sucker *Catostomus latipinnis* and Bluehead Sucker *Catostomus discobolus* within the study reach. In fact, the Grand Canyon fish community is dominated by native fishes, which comprise over 90% of the catch in larval and small-bodied samples. The composition of native fish in the Grand Canyon is much higher than in any other major river in the Colorado River basin, suggesting that the Grand Canyon serves as a native fish stronghold. Some biologists have suggested that the proportion of native fish in the Grand Canyon has shifted in the last few years, possibly as a result of warming water due to lower lake elevations in Lake Powell, expanding riverine sections in the LGC due to lower lake elevations in Lake Mead, or other conditions that give native species an advantage over nonnative ones. Pending additional planning and compliance, this work may continue in 2017; all work is funded directly by Reclamation and the NPS provides logistical support.

1.4 Role of the 2017 Science Panel

Panelists were presented with available information and reached independent conclusions regarding how to proceed with Razorback Sucker work. This report presents the results of an evaluation conducted by a Science Panel and presents their recommendations on a review of the summarized 2012 Science Panel recommendations (section 1.2). The 2017 Science Panelists were also asked to analyze five additional key questions:

- 1) *Is the ongoing study useful to assess Razorback Sucker use of the Grand Canyon?*
- 2) *How could the ongoing study be improved to better understand Razorback Sucker use of the Grand Canyon and the Colorado River Inflow Area of Lake Mead?*
 - a. *Could the study be modified to provide additional information for other fish using the Grand Canyon?*
- 3) *What additional studies (e.g., genetic evaluation for hybridization or genetic N_e evaluation for population size) would be useful to pursue in helping to further determine the status of Razorback Sucker in the Grand Canyon and the Colorado River Inflow Area of Lake Mead?*

- 4) *Should Reclamation and the USFWS proceed with efforts to introduce additional Razorback Suckers into the Grand Canyon or Colorado River Inflow Area of Lake Mead?*
 - a. *Should tributaries be stocked?*

- 5) *If appropriate, what methods or strategies should be considered in introducing Razorback Suckers into the Grand Canyon?*
 - a. *What fish (i.e., genetic stock) should be used?*
 - b. *How many fish and how many stocking efforts?*
 - c. *What age-class should be stocked?*
 - d. *Hard vs. soft release?*
 - e. *Suggested monitoring to evaluate success?*

1.5 Members of the 2017 Science Panel

A list of prospective panelists was compiled by Reclamation, and panelists were selected based on their availability and subject matter expertise. It was desirable to have a cross-section of experts with experience and expertise in the lower and upper subbasins 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.

The 2017 attending Science Panel members included:

Thomas Chart

Director, Upper Colorado River Endangered Fish Recovery Program, U.S. Fish and Wildlife Service, Lakewood, Colorado

Matthew Chmiel

Aquatic Wildlife Program Manager, Arizona Fish and Game Department, Region 3, Kingman, Arizona

Dr. David Propst, Ph.D.

Retired Endangered Species Biologist, New Mexico Department of Game and Fish; currently University of New Mexico, Albuquerque, New Mexico

Dale Ryden

Project Leader, Colorado River Fishery Project, U.S. Fish and Wildlife Service, Grand Junction, Colorado

Brandon Senger

Supervising Fisheries Biologist, Nevada Department of Wildlife, Las Vegas, Nevada

Melissa Trammell

Fisheries Biologist, National Park Service, Grand Junction, Colorado

Dr. Thomas Turner, Ph.D.

Professor and Associate Dean for Research, University of New Mexico, Albuquerque, New Mexico

Dr. Richard Valdez, Ph.D.

Senior Aquatic Ecologist, SWCA, Environmental Consultants, Logan, Utah

2.0 DISCUSSION

2.1 Updated 2017 Science Panel Discussion of the Original 2012 Science Panel Questions with Observations for Moving Forward

The 2012 Science Panel’s summary (section 1.2) was discussed in depth following detailed research presentations, and panelists made observations on those past recommendations as a group. These observations and language used were agreed upon as a group, and only in some cases were ranked by importance. While in some cases panelists did not agree completely on actions taken (e.g., stocking or lack thereof), a consensus was reached by vote and is recorded below.

1) Continue ongoing work with Razorback Sucker at the Colorado River Inflow Area and throughout Lake Mead.

1) No additional recommendations were made. The panel appreciated the studies in their current form and recommended that they continue.

Discussion Points: There was little discussion on this recommendation as all panelists thought the Lake Mead Razorback Sucker telemetry studies and surveys for small-bodied and larval fish in the Grand Canyon are valuable, unique, and incredibly important considering Lake Mead is the only documented location with a naturally self-sustaining Razorback Sucker population.

2) *Do not force augmentation (i.e., stocking) of Razorback Sucker. If stocking is done, use translocated, wild Razorback Suckers (or wild larvae from the lake population).*

- 1) **Over 50 sonic-tagged “Judas” fish have been stocked into the Colorado River Inflow Area of Lake Mead or the Grand Canyon. The panelists felt the use of fish for this purpose was consistent with the 2012 recommendations.**
- 2) **Panelists caution to not use “too many” hatchery-reared fish and instead encouraged the use of wild, Lake Mead fish to address research concerns.**
- 3) **Consider the transfer of Lake Mohave fish to enhance genetics within Lake Mead, if necessary. The panelists felt this was likely under the purview of the Lake Mead Work Group.**
- 4) **The Colorado River in the Grand Canyon and its inflow to Lake Mead is still dynamic, and there may be insufficient information to fully understand the status of the population.**
- 5) **Use genetic markers for larval fish, if possible, to try to estimate size of the spawning population.**

Discussion Points: The panelists were impressed with the use of telemetry, particularly in isolating RM 243 and 246 (approximate) as seemingly important areas, and in describing the extent of movement by Razorback Sucker (e.g., at least as far upstream as Pipe Spring [RM 89]). Participants expressed the hope that future researchers might be able to expand efforts and more intensively track Razorback Suckers in the hopes of finding “aggregations.” Furthermore, the combined sonic- and radio-telemetry tags will also aid in identifying locations of tagged fish (new to the study, initiated during the 2016 project year). In regards to stocking Razorback Sucker within the LGC, nearly all panelists voted against stocking except in the occasional case of sonic- or radio-tagged fish. Several panelists mentioned that wild-caught Lake Mead fish should be used to fully alleviate any hatchery domestication concerns. Furthermore, the panel thought it would potentially be beneficial to stock fish higher in the system (e.g., Bright Angel Creek [RM 88]) to determine movement from an upstream location. The issue of Lake Mead genetic resiliency (inbreeding depression) was discussed; however, it was not yet considered a concern by the panel’s geneticist, and there doesn’t appear to be a good reason for stocking Lake Mead with Razorback Sucker from outside the system. It was also noted that stocking fish of Lake Mohave genetics in Lake Mead was a different issue and discussion and not a concern for

this panel. The idea that currently we may have a “window” for Razorback Sucker to establish in the Grand Canyon was discussed, but swamping the wild population through stocking was thought to be concerning as this population is considered to be dynamic and successful (i.e., don’t break what’s working). Larval fish genetic research was of interest and discussed. It might be possible to estimate a minimum number of parents that contributed to larvae (with potentially large uncertainties), and Drs. Thomas Dowling and Thomas Turner are currently working on mapping the Razorback Sucker genome and isolating genetic markers to answer these questions.

3) *Integrate all information on fish and food base in the Grand Canyon and the Colorado River Inflow Area of Lake Mead.*

- 1) **Relate habitat and habitat persistence to Glen Canyon Dam operations and hydro-peaking flows.**
- 2) **What are the geomorphological changes at the Colorado River Inflow Area of Lake Mead, and what does that mean for the future of Razorback Sucker in LGC and Lake Mead?**
- 3) **Critical questions are listed below with regard to survival of larval Razorback Sucker. Why aren’t we seeing more juveniles?**
 - a. Are low-velocity habitats adequate as nursery areas to advance the developmental stages of Razorback Suckers in the Grand Canyon?
 - b. Does the Colorado River Inflow Area of Lake Mead provide important nursery habitat for larval and early juvenile Razorback Suckers?
 - c. What is the primary food source for post-larvae juveniles in the Colorado River Inflow Area of Lake Mead?
 - d. What is the fate of larvae from the Colorado River? The Science Panel recommends conducting additional larval sampling in the Colorado River Inflow Area of Lake Mead to determine whether larvae are being transported out of the river and into the inflow area.
- 4) **Some panelists felt more information needs to be gathered on the food base, with possible options explored (e.g., the Grand Canyon Monitoring and Research Center expanding studies downstream below Diamond Creek).**

5) Fundamental question: What led to initial expansion of Razorback Suckers within Lake Mead (e.g., increase/decrease in upstream and downstream [Lakes Powell and Mead], reservoir elevation)?

Discussion Points: Dr. Valdez first encouraged peer-reviewed publication of anything applicable to this recommendation in order to lay a foundation and base of knowledge for future work. It was mentioned that particular attention may be paid to RM 150 (approximate), as the data seem to show a breaking point between higher catches of larval Razorback Suckers and native small-bodied fishes to lower catches upstream of that point. Furthermore, tributaries should be explored when possible to help elucidate their role for spawning catostomids. Pursuant to the question of food base in the LGC, there was at least one study that classified the river upstream of the Diamond Creek inflow as a “food desert”; however, studies have not been conducted to date below this point. Larval fish surveys, however, indicate development beyond the earliest larval phase into juvenile phase for all native species including Humpback Chub. Certain panelists were hopeful that the work of Dr. Ted Kennedy of the Grand Canyon Monitoring and Research Center might be able to fill in the knowledge gaps related to the food base below Diamond Creek. It was expected that Razorback Sucker were extirpated from Lake Mead by the 1980s, considering none had been captured between 1980 and 1989 (Sjoberg 1995); therefore, the panel discussed where these fish originally came from. It was expected that a few fish survived all along but that something changed that was favorable enough to allow this Razorback Sucker to expand the population. If there was indeed a change, the panelists wondered what would happen if lake levels rise again. Furthermore, the panel suggests that investigations within the Virgin River could be an additional avenue of research to help explain the self-sustaining nature of the Lake Mead population of Razorback Sucker.

4) *Expand fish surveys for Razorback Sucker, in the lower Grand Canyon and investigate larval fish to get evidence of spawning and use of river.*

- 1) **Expand larval sampling into the Colorado River Inflow Area delta in Lake Mead to better understand the fate of Razorback Sucker larvae.**
- 2) **The Science Panel concurs with the decision to expand sampling upstream to Bright Angel Creek, but it recommends that any additional expansion be referred back to the Science Panel if/when needed.**
- 3) **Evaluate the effect(s) of Glen Canyon Dam operations, including variable flows, on backwaters. It is important to understand the effect of flow on backwaters, but this is not a top priority at this time.**

Discussion Points: This Science Panel considers this recommendation to be fulfilled, and the panel recommends that the study continue under current methodologies. All panelists supported the 2016 decision to move sampling upstream to Bright Angel Creek, but they do not see the

need to continue expanding the study upstream at this time. The panel advised reassembling if researchers strongly desire to adjust current sampling methods. Moving upstream to find the furthest upstream spawning area is certainly of interest to some, but the panelists agreed that data collection should remain consistent whenever possible. Some would also like more targeted sampling or opportunistic sampling. Although some increased sampling could be done by the small-bodied crew in tributaries, larval crews would not be able to take additional samples due to tribal concerns about take. It was additionally mentioned that Glen Canyon Dam operations likely have an impact on nursery habitats, and any work to understand that connection would be desirable.

2.2 Final Questions for the 2017 Science Panel

Reclamation sent five questions to all panel members prior to the meeting. These questions were posed following the revisited 2012 summary points in order to provide a concise view of Razorback Sucker research in Grand Canyon and the Colorado River Inflow Area moving forward. Given the above, coupled with the recent work in the Grand Canyon, the following key questions were addressed by the January 2017 Science Panel:

1) *Is the ongoing study useful to assess Razorback Sucker use of the Grand Canyon?*

Yes. Researchers should continue work between Bright Angel Creek and Pearce Ferry in order to obtain a dataset using consistent effort and methods. If possible, conducting additional sampling below Pearce Ferry to assess larval transport and nursery habitat availability at the inflow is advised.

2) *How could the ongoing study be improved to better understand Razorback Sucker use of the Grand Canyon and the Colorado River Inflow Area of Lake Mead?*

a. *Could the study be modified to provide additional information for other fish using the Grand Canyon?*

Researchers should make no significant changes to the sampling design, other than as mentioned above. The panel suggests viewing this program as a long-term baseline for the Colorado River Inflow Area of Lake Mead and recommends an additional 5 years of study using the current methodology. It is recommended that a Science Panel be reconvened at that time to assess findings and provide future steps.

3) *What additional studies (e.g., genetic evaluation for hybridization or genetic N_e evaluation for population size) would be useful to pursue in helping to further determine the status of Razorback Sucker in the Grand Canyon Colorado River Inflow Area of Lake Mead?*

Researchers could use genetic markers to evaluate hybridization as well as parental stock (N_e).

- a. The panel recommends a concerted study to collect samples specifically for genetic evaluation.
 - b. The panel recommends continuing to collect fin clips of adult fish.
- 4) *Should Reclamation and the USFWS proceed with efforts to introduce additional Razorback Suckers into the Grand Canyon or Colorado River Inflow Area of Lake Mead?*
- a. *Should tributaries be stocked?*

No (section 2.1, question 2).

- 5) *If appropriate, what methods or strategies should be considered in introducing Razorback Suckers into the Grand Canyon?*
- a. *What fish (i.e., genetic stock) should be used?*
 - b. *How many fish and how many stockings?*
 - c. *What age-class should be stocked?*
 - d. *Hard vs. soft release?*
 - e. *Suggested monitoring to evaluate success?*

Again, no introduction is recommended at this time.

2.3 Conservation Measures from the Long-Term Experimental Plan Biological Opinion Related to Razorback Suckers

The following Conservation Measures were being developed as the Science Panel review was being planned and finalized (USFWS 2016). Due to timing the Science Panel did not evaluate the importance or priority of these new Conservation Measures; however, continuing the work, with some small modifications, could likely contribute to the fulfillment of these measures.

- *“Reclamation would continue to assist the NPS, FWS, and the GCDAMP in funding larval and small-bodied fish monitoring in order to:*
 - *Determine the extent of hybridization in Flannelmouth and Razorback Sucker collected in the western Grand Canyon.*

- *Determine habitat use and distribution of different life stages of Razorback Sucker to assist in future management of flows that may help conserve the species. Sensitive habitats to flow fluctuations could be identified and prioritized for monitoring.*
- *Assess the effects of Trout Management Flows (TMFs) and other dam operations on Razorback Sucker.”*

3.0 CONCLUSION

All panelists had a positive impression of the consequential research being conducted within the Colorado River of the Grand Canyon and within Lake Mead. It was echoed that merely 5 years ago, no one would have expected the positive results being reported, which exceed expectations. One panelist also stressed the importance of the inflow/river connection, and highlighted the importance of maintaining a joint study rather than separating the two.

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