

Summary of Leadership and P&I Technical Analyses and Comments regarding FY2022 Bug Flows (in alphabetical order)

August 9, 2022

Entity	Leadership Team	Leadership Team Position	Technical Team	Written TT Position
Arizona	Kristen Johnson	Discontinue	Emily Higuera	Discontinue
AZGFD	Julie Carter	Continue	Dave Rogowski	Continue
BIA	Chip Lewis	Continue	Chip Lewis	Continue
BOR	Daniel Picard	Continue	Kathy Callister	Continue
California	Jessica Neuwerth	Abstain	Shana Rapoport	Discontinue
Colorado	John McClow	Continue	Michelle Garrison	Discontinue
FWS	Mark Lamb	Abstain	Kirk Young	Abstain
Nevada	Colby Pellegrino	Discontinue	Seth Shanahan	Discontinue
New Mexico	Ali Effati/Colleen Cunningham	Discontinue	Christina Nofstker	Discontinue
NPS	Ed Keable / Billy Shott/ Louis Rowe	Continue	Brian Healy/Buddy Fazio	Continue
UCRC	Chuck Cullom	Discontinue	Sara Larsen	Discontinue
USGS	Scott Vanderkooi	Continue	Mike Moran	Continue
Utah	Amy Haas	Discontinue	Scott McGettigan	Discontinue
WAPA	Rodney Bailey/Brian	Discontinue	Shane Capron	Discontinue
Wyoming	Charlie Ferrantelli	Discontinue	Mel Fegler	Discontinue

ARIZONA

P&I Team - Arizona Department of Water Resources (ADWR) leadership is in favor of discontinuing Bug Flows this year, given that 2 of the 3 offramps have been met.

Currently, ADWR does not feel that enough evidence has been presented to warrant the continuation of Bug Flows; as the risks associated with establishment of Smallmouth bass are too high. ADWR does not feel the risk is worth the reward, as it has been noted a potential, albeit likely small benefit to Smallmouth bass. The Dam is being operated in unprecedented times, within consistent rough zones. As water managers, it is irresponsible to continue this experiment without solid evidence. ADWR appreciates GCMRC, NPS, and AGFD's assessment, and acknowledge the difficulties in quantifying a direct correlation between temporary Bug Flows and smallmouth bass reproductivity. However, Low velocities and a stable spawning habitat are necessary for Smallmouth bass reproduction. While the period of steady flows is short, allowing any additional opportunities for Smallmouth bass success is unacceptable if the management goal is to deter their establishment. While ADWR sympathizes with the increasing temperatures and increasing metabolic rate of fish, a larger food base will also provide an advantage to opportunistic Smallmouth bass that may be present. Sampling of the -12 mi slough post initial Smallmouth bass detection has yet to reveal additional individuals. This is a concern as Smallmouth bass are known to spawn in large quantities, and any chance or opportunity provided to ensure those remaining and unaccounted for from the initial spawning event's survival should be a concern. It is also a concern that the peak and higher weekday CFS associated with Bug Flows may allow for more entrainment. Rising temperatures and increased entrainment due to elevations have been cited as the largest contributing factor to Smallmouth bass success. If this is true, the possibility of heightened entrainment from the higher weekday flows should be under higher scrutiny. Although GPP increases have not been observed in Lees Ferry, it cannot be assumed that Smallmouth will not inevitably be making their way downstream. The Paria has flooded this season, therefore ending the clear water season. GPP can only occur under clear to moderately clear conditions, therefore lowering the effectiveness of Bug Flows. By the time there may be a clear understanding of the listed unknowns, it may be too late. ADWR prefers to remain on the side of caution. This is an action that can be taken swiftly, whereas others will require a possibly lengthy process. ADWR would like to be as proactive as possible and take the action available if there is an opportunity to prevent the establishment of Smallmouth bass.

AZ GAME AND FISH

P&I Team - AZGFD - GCD Planning and Implementation Team- Considerations for Offramping '22 Bug Flows. The Arizona Game and Fish Department is highly concerned with the prospect of establishment of smallmouth bass (SMB) and other high-risk non-native fishes and the negative effect that these species will have on the rainbow trout population and the native fish assemblage downstream of Glen Canyon Dam. The observation of young of the year bass in the lower slough at Lees Ferry is cause for concern and was identified in the Bug Flow implementation recommendation report as one criterium for triggering discussion of offramping these flows; however, we have concluded that continuation of bug flows does not represent an increased risk of SMB establishment below the dam this year, sharing the position of the science center and other wildlife management agencies within the program.

High water temperatures coming through Glen Canyon Dam and the increased risk of fish entrainment due to low reservoir elevations are the overwhelming driving factors for SMB establishment downstream of the dam. As such, the decision to cease or continue bug flows will not meaningfully change the risk of establishment of smallmouth bass or other high risk non-natives if water temperatures continue to be elevated (>20°C) through August, which is projected. Bug flows

do not have the capacity to lower the water temperature nor prevent fish from becoming entrained through the dam or otherwise change the underlying conditions that pose the greatest threat for SMB establishment. The Department continues to stress the importance of prevention measures, which include lowering release temperatures and reducing entrainment of fish at the dam, in order to be effective for long term control of high risk non-native species.

We acknowledge that there are valid tradeoffs, competing perspectives based on values, and other policy-based decisions when considering whether to offramp bug flows that include cost or impacts to water resources that will be considered by BOR and the Leadership Team. Fisheries scientists also recognize the uncertainty (as are all things in science) in whether bug flows increase the risk of establishment of SMB. There is consensus, however, among those biologists who have provided guidance and technical consideration during this year's implementation of bug flows and subsequent discussion of offramping, that the magnitude of any effect would be small (whether positive or negative) and negligible in the context of the high water temperature in the system under current water conditions. Additionally, steady flows that match weekday lows are not likely to disproportionately benefit SMB, especially for the short duration experienced in bug flows and within the current conditions in the system.

The argument that if there is even a small reduction in the risk to SMB, why wouldn't the program cease bug flows, ignores the fact that the direction of risk is uncertain and disregards the potential benefits the bug flows provide to downstream resources (e.g. macroinvertebrate emergence/productivity, GPP increases, better fishing, etc.). Additionally, it disregards the complicating effect that terminating an experiment early has on the interpretation of the results from this bug flow year (i.e. reduced ability to infer response from downstream resources; loss of a true replicate in the experiment).

For the reasons stated above, AZGFD recommends continuation of bug flows through this year's implementation schedule.

BIA

Leadership Team - BIA's recommendation is to CONTINUE the 2022 bug flow experiment. This recommendation is based on the Subject Matter Experts' (Fish Biologists) opinion that continuation will have no significant impact on smallmouth bass proliferation.

P&I Team - BIA's vote will be/is to continue the bug flow experiment if the biological data supports.

BOR

Leadership Team - Reclamation's position is to continue the 2022 Bug Flows Experiment based on expert opinion and information provided by GCMRC, which states "continued testing of experimental Bug Flows does not meaningfully increase this risk via a food base effect in Grand Canyon, nor will prematurely ending the 2022 Bug Flows experiment meaningfully reduce risk."

P&I Team - Reclamation's technical position is to continue the 2022 Bug Flows Experiment based on expert opinion and information provided by GCMRC, which states "continued testing of experimental Bug Flows does

not meaningfully increase this risk via a food base effect in Grand Canyon, nor will prematurely ending the 2022 Bug Flows experiment meaningfully reduce risk.”

CALIFORNIA

P&I Team - Based on last week’s meeting, it’s not clear to me precisely what impact bug flows might have on smallmouth bass entrainment (related to release pattern) or survival (related to low/steady flow or fluctuation). However, by the time we have a better understanding of the magnitude or direction of these effects, the window to act will be long closed. Given that we are in uncharted territory, I see value in a risk-averse approach. Although it seems that bug flows likely represent only a small increase in risk, marginal increases in risk could have an outsized effect as we fight to prevent smallmouth bass establishment below the dam. As we develop solutions in the coming months that address the larger levers on smallmouth bass establishment, California plans to advocate for a similarly risk-averse approach.

With all that in mind, California is in favor of discontinuing the experiment this year. Over the next several months, we would like to see investigation continue into the interactions between smallmouth bass and dam releases, in order to inform future decisions on bug flows.

COLORADO

P&I Team - Colorado supports ceasing the bug flow experiment at this time for many of the same reasons mentioned in the information provided by UT, NM and CA

FWS

Leadership Team - we ABSTAIN from voting to discontinue or continue the spring 2022 GCD Bug Flow based on P&I Recommendation below.

P&I Team - This is a question for which there is no clear technical data from which to guide a decision. We considered three areas in evaluating the question on whether to discontinue the Bug Flow experiment:

1) Risk of maintaining the experiment. The Service is exceedingly concerned over risk for establishment of Smallmouth Bass (SMB) in Grand Canyon. Risk can be defined as the combination of likelihood and consequence of an outcome. We think there is a low likelihood that Bug Flows will significantly advantage SMB, however consequences of SMB establishment in Grand Canyon are immense. Based on risk avoidance alone, the Service, as responsible for recovery of T&E species and necessarily risk averse to the potential for population level effects to Humpback Chub, would support discontinuing the experiment.

2) Process as outlined in the EIS. There is also process we have agreed to hold ourselves accountable to regarding discontinuing experiments as AMWG members:

For these experiments, effectiveness would be monitored and the experiments would be terminated or modified only if sufficient evidence suggested the treatment was ineffective or had unacceptable adverse impacts on other resources...

...All experimental treatments will be closely monitored for adverse side effects on important resources. At a minimum, an unacceptable adverse impact would include significant negative impacts on resources as a result of experimental treatments that have not been analyzed for the proposed action in the LTEMP EIS.

Our ability to conduct experiments and obtain information needed to manage Grand Canyon resources is dependent upon our commitment to this process. Consequently, from a process standpoint, the Service does not think that this process standard is reached for Bug Flow's influence on SMB in order to off-ramp the experiment. Thus, from a process standpoint, we would recommend continuation of the experiment.

3) Action required to manage risk. The risk of SMB will not likely be managed or effectively reduced without significant future management actions. Short term, these include:

- A. Elimination of SMB within the slough (that may require low releases for a few days);
- B. Some level of SMB monitoring and Rapid Response effort to buy time for large scale actions; and,
- C. Effective large-scale actions that will prevent or significantly reduce the risk of SMB establishment.

Without decisive and effective actions in the future, SMB will likely establish in Grand Canyon resulting in substantial negative effects to Humpback Chub and other species, regardless of the Bug Flow experiment continuation decision. Thus, a Bug Flow cessation decision would seem to be independent of a SMB current or future status, as we think that SMB status is wholly dependent upon future actions.

Due to these three contrasting considerations, the Service abstains from a position on whether to discontinue Bug Flows. We recommend the considerable knowledge, skill and talent of the AMWG stakeholders continue to be applied to actions that will be necessary to avoid establishment of SMB in Grand Canyon.

NEVADA

P&I Team - Nevada supports ceasing the bug flow experiment at this time for some of the same reasons mentioned in the information provided by CA, CO, AZ, NM, UT and WY.

NEW MEXICO

P&I Team - Thank you for the opportunity to provide our technical reasons for recommending that this year's the bug flow experiment be stopped. As noted during the discussion by the P&I team on July 14, two of the three off-ramps have been reached. We believe the science shows that macroinvertebrate flows have the potential to benefit warm water species like the smallmouth bass. We understand that determining if that benefit to smallmouth bass is significant is difficult to parse, nonetheless, we do not feel that the risk of potentially advantaging SMB through the bug flow experiment is acceptable.

Continuing the bugflows will likely further create optimal conditions for SMB with improved nearshore stabilization and additional warming of the river. We agree, SMB may become established without bugflows, but do not feel continuing the bugflows is prudent in light of the risk to ESA-listed species in the canyon. We believe it is necessary to consider ways to disadvantage SMB with minimal impacts to native fish species and hydropower generation. New Mexico provided its ideas through SBAHG on July 7, 2022. We feel sufficient evidence is present to recommend immediate cessation of the bugflows.

NPS

Leadership Team - GRCA supports the continuation of the bug flows through the end of August as originally envisioned. Our scientists, along with those from the other agencies, do not have any evidence to suggest that continuation of the experiment will accelerate the establishment of smallmouth bass within the Colorado River in either Glen Canyon or Grand Canyon, so we see no

reason to discontinue the bug flow experiment for this year. We also think it is important to let the study play out as originally planned so that data is not lost or skewed. We believe changing the parameters of the study can also increase risk of inability to defend the science or management actions derived from the science in future court actions, should these occur.

P&I Team - We recognize that we should, and did, take a careful and clear look at the potential for bug flows to benefit smallmouth bass reproduction, we do not believe there is evidence that bug flows are contributing to smallmouth bass survival or reproduction. The mechanisms suggested for this to occur are increases in temperature relative to the main channel, and stability of habitat. Steady flows that match weekday lows do not appreciably add to conditions favorable for smallmouth bass more than what is already happening in the system.

Release temperatures from the dam are above critical minimums for smallmouth bass reproduction (16 degrees C) and have been since the middle of June. River temperature at Lees Ferry has been above 16 since the first week of June – this temperature increase is unrelated to bug flows and temperatures continue to increase (Figure 1). When the larval SMB were first collected, on June 30, they were approximately 25-28 days post-spawn (Dr. Kevin Bestgen, pers. Comm.), meaning they were spawned on approximately the first week of June. A reasonable assumption is they were spawned and hatched in the slough (not hatched in Lake Powell); however, the adults would have come through earlier, most likely when the lake was at its lowest level in March/April. With Lake Powell and release temperatures above 16, adult bass were able to mature either in the lake or in the river, and then, finding the warmer, low velocity slough, they found suitable habitat for spawning. Bug flows did not change this temperature dynamic. Temps are always warmer in the back of the slough, even during higher volumes and fluctuations such as seen in 2015.

Smallmouth Bass require near-zero velocity to successfully spawn and reproduce. However, they require at least a month of stable low-velocity habitat to complete reproduction, from nest building to the dispersal of fry from the nest. Since weekend flows are not long enough to complete this cycle, we must conclude that velocities are suitable in the slough during weekday fluctuations as well as weekend steady flows. Thus, weekend steady bug flows are unlikely to have contributed to spawning success through stability of habitat. Furthermore, we do not believe that increasing fluctuations will effectively limit SMB growth and reproduction at the current release volumes.

There are reasons to continue the bug flow experiment. There are observed benefits to native fish during previous bug flow experiments, particularly native flannelmouth sucker. Also, we know as river temperatures increase, metabolic demand for food for native fish increases, and we would want to do everything we could to enhance the food base to support the increased metabolic demand and maintain or increase native fish production. We recognize this may be true for nonnative warm water species as well; however, currently the benefit to native fish would likely far outweigh any potential benefits to new invasive species that are not yet established throughout Grand Canyon.

We would prefer to see the bug flow experiment continue for this year, since we are unlikely to implement this experiment next year, as we hope to have other flow alternatives in place that directly suppress SMB instead.

UCRC

P&I Team - This past spring, due to concerns expressed by some members of the P&I Team regarding potential negative impacts from “bug flow” experiments, Reclamation included three offramps that could trigger a review of the experiment for termination. The three offramps were:

- Negative resource impacts related to the detection of juvenile smallmouth bass (SMB) in Lees Ferry and/or observations that indicate the bug flow experiment could benefit SMB
- Increased cost
- Reduced releases from Glen Canyon Dam

The reduced releases from Glen Canyon Dam have occurred due to the May 3rd letter for 2022 operations. The second offramp, negative resource impacts, is implicated by the recent observation of SMB below Glen Canyon Dam. While projected costs of the experiment due to reduced hydropower revenue from steady flows have not increased dramatically, there appears to be a modest increase in the projected cost. Given that two of the three agreed-upon triggers for reconsideration have now occurred, and in an abundance of caution regarding the further establishment of SMB in the reach below Glen Canyon Dam, many of the PI Team members from the States and non-federal parties, have requested reconsideration and the early termination of the bug flow experiment. Similarly, in an abundance of caution, the UCRC also supports this reconsideration and the early termination of the experiment and recommends that these concerns be elevated to either the Leadership Team or the Secretary of the Interior or her Designee in an expeditious manner.

USGS

Leadership Team - Discussed this issue at length with GCMRC scientists with expertise on Colorado River aquatic ecology, fish biology and population dynamics, hydrology and water quality, and risk assessment of dam operations and current conditions. Their conclusion based on the best available science is that there is no meaningful change in the risk of Smallmouth Bass establishment downstream of Glen Canyon Dam if the Bug Flows experiment is continued or terminated. Therefore, my recommendation is that the Bug Flows experiment continue through its planned conclusion at the end of August.

P&I Team - The best available science continues to show that the Bug Flow experiment can improve natural processes of the Colorado River downstream of Glen Canyon Dam (Deemer and others, 2022) including increases in food base productivity and aquatic insect diversity. These natural resource benefits are predicted to propagate up to increase native fish growth, food web stability, and ecosystem health. The Science Advisors concluded that Bug Flows met the experimental objectives described in the LTEMP (i.e., improve food base productivity and insect diversity). The Science Advisors also noted that additional Bug Flow replicates would reduce uncertainties concerning benefits to native fish and inform future design considerations for the experiment. Because of these identified benefits to natural resources and learning, the USGS recommended a fourth replicate of the Bug Flow experiment be tested in 2022.

The Planning and Implementation Team (PI Team) report identified three potential offramps for the experiment. One of these offramps that may warrant the PI Team to consider recommending termination of implementation is: “Detection of juvenile smallmouth bass in Lees Ferry and/or observations that indicate the experiment could benefit smallmouth bass.” Recent observations and collections of Smallmouth Bass in the Lees Ferry reach including in the Slough mean that this offramp for further discussions has been met.

We acknowledge comments from PI Team members stating a desire to off-ramp from the Bug Flow experiment owing to recent detections of Smallmouth Bass. Comments in support of recommendations to off-ramp are generally framed around the hypothesis that stable flows like Bug Flows will lead to further increases in nearshore warming or near-shore stability compared to load-following, and this will in turn increase rates of Smallmouth Bass growth, survival, or spawning. These comments cite prior steady flow experiments from 2000 and 2008-2012, which sought to increase water temperatures in nearshore habitats in support of native fish goals, as evidence that Bug Flows are a strong lever on nearshore water temperature and in turn Smallmouth Bass growth.

USGS did not explicitly mention or flag a link between Bug Flows → warming → Smallmouth Bass establishment in the PI Team report, because the best available science does not support the hypothesis that changes in water temperature arising from Bug Flows will affect fish growth. At the time the PI Team report was written in April 2022, it was predicted that Glen Canyon Dam release temperatures would approach 20C and would therefore be above thresholds for Smallmouth Bass spawning and growth. In contrast, the steady flow experiments in 2000 and 2008-2012 occurred in the context of cold-water releases, with maximum temperatures of 11-14C, depending on year. A primary goal of these steady flow experiments was increasing temperatures in nearshore habitats with the goal of driving temperature above thresholds for humpback chub growth (12C) and spawning (16C). However, detailed investigation of nearshore habitats during these experiments showed that nearshore warming arising from steady flows was minor, localized, and ephemeral, and unlikely to meaningfully increase native fish growth or survival.

Insights from these prior steady flow experiments informed design of the 'low summer flow' experiment described in LTEMP. The low summer flow experiment is the only experiment in LTEMP that targets native fish growth through flow-based increases in water temperature. The low summer flow experiment can only be tested in the second 10 years of LTEMP, and only if temperatures at the Little Colorado River confluence are predicted to be less than 14C. By lowering mean discharge, rates of downstream warming will increase, and by driving river-wide temperatures above the 12C threshold for Humpback Chub growth, this modest, flow-based, increase in temperature could have outsized ecological benefits. The experiment would not be implemented if temperatures were too cold to even reach 14C at river mile 61, nor would the experiment be implemented if temperatures would naturally reach 14C at this location. Notably, although mean discharge will be relatively low if this experiment is implemented, daily fluctuations in discharge for hydropower production are included in the 'low summer flow' experimental design, because the best available science demonstrates that steady flows are not a useful tool for managing water temperatures in support of native fish goals.

In the Planning and Implementation (PI) Team report, USGS left open the possibility that a link between Bug Flows → Food base → Smallmouth Bass establishment could exist. We noted that increases in gross primary production and insect diversity that were arising from Bug Flows could potentially be utilized by Smallmouth Bass. Nonetheless, we concluded that any food base effect would be inconsequential, because at this stage of the invasion Smallmouth Bass are not food limited. We also noted that any food base effect would not meaningfully affect risk of Smallmouth Bass establishment compared to two primary sources of risk in 2022—high rates of Smallmouth Bass entrainment through the dam and high release temperatures that are near optima, both of which are related to low reservoir elevations.

The comments from PI team members recommending an off-ramp imply that Bug Flows have a strong effect on water temperatures and, in turn, Smallmouth Bass establishment. In contrast, the best available science shows that even in the context of cold-water releases, long duration steady flows have weak, highly localized, and ephemeral effects on nearshore water temperatures. In the context of 20C releases from Glen Canyon Dam, any

changes in nearshore water temperatures arising from stable Bug Flow releases two days per week will be inconsequential.

The comments from PI team members also imply that load-following flows 7 days per week will lower the risks of Smallmouth Bass establishment compared to continuing with weekend Bug Flow releases. It is unclear what evidence is available to support this assumption, and we point to the hypothesis that USGS recently put forward at PI Team meetings that describes how load-following operations may increase entrainment of Smallmouth Bass through the dam. This hypothesis is grounded in field studies showing that rates of entrainment of fish through dams are positively related to discharge magnitude, the implication being that daily increases in releases associated with load-following may be leading to higher rates of entrainment. This hypothesis is corroborated by recent field observations, which were shared at PI Team meetings, of herons and other fish-eating birds arriving at the tailrace of Glen Canyon Dam in the afternoons to prey on Threadfin Shad and other fish that were floating by, having not survived passage through the dam. During these discussions, PI Team members noted that testing Bug Flows on weekends leads to higher daily peaks during the week, the implication being that any reductions in entrainment on weekends may be offset by slightly higher entrainment on weekday load-following.

In closing, we note that the best available science indicates Bug Flows may be having small positive or negative effects on Smallmouth Bass establishment. In our professional opinion, we see no meaningful change in risk of Smallmouth Bass establishment if Bug Flows are continued or terminated via either food base or temperature effects, and we recommend that Bug Flows be continued through August as originally planned to maximize resource and learning benefits.

Reference cited:

Deemer, Bridget R., Charles B. Yackulic, Robert O. Hall Jr, Michael J. Dodrill, Theodore A. Kennedy, Jeffrey D. Muehlbauer, David J. Topping, Nicholas Voichick, and Michael D. Yard. "Experimental reductions in subdaily flow fluctuations increased gross primary productivity for 425 river kilometers downstream." *PNAS Nexus* 1, no. 3 (2022): pgac094.

UTAH

P&I Team - Utah's technical position on the continuation of the 2022 Bug Flows Experiment, in light of the discovery of young of year smallmouth bass in the lower slough, is to discontinue the experiment for the remainder of CY 2022. There has been much discussion over the past few weeks about the potential effect of the experiment on non-native fish populations in the Glen Canyon section of the river, and the positive impacts on native fish in the reaches below Lee Ferry have been touted in the past. Much of the technical perspective relative to concerns over how the experiment may benefit smallmouth bass has centered around language such as "unlikely" and "minimal impact". While these assessments are founded in the best current scientific understanding of the ecosystem, they lack the technical certainty that would be preferred under the emergency we are facing. More certain answers to these questions could be learned with time, however, delaying action increases risk. The hazards for native fish populations associated with the establishment of smallmouth bass in the Grand Canyon, as has been noted by river science experts, are too great to let any opportunity to reduce this risk slip by. For this reason Utah recommends immediately ceasing the 2022 Bug Flows Experiment.

WAPA

Leadership Team - WAPA recommends that the 2022 Bug Flow experiment be discontinued immediately. Our detailed reasoning is documented in the P&I Analyses paper, dated August 3, 2022. The impacts to the system and resource goals if SMB were to become established in the system is significant. In addition, WAPA and our customers continue to experience significant financial impacts due to the drought, and face exceptional risk to our operations for the foreseeable future.

P&I Team - As discussed by the PI Team for the bug flows experiment, two of the three offramps have been reached (smallmouth bass spawning below Glen Canyon Dam and a reduction in summer release volumes). The third offramp, the doubling of the cost estimate to hydropower, has likely not been reached, however we would point out again the sustained high estimates for this experiment of around \$1.4M. Reaching these offramps suggest it may be prudent to stop this steady flow experiment given the potential for the establishment of smallmouth bass below Glen Canyon Dam, and the potential risk to ESA-listed species.

Mainstem water temperatures reached 19.9° C at Lees Ferry and 20.3° C at the LCR last weekend during the weekend steady flow release of July 16-17 and are expected to get warmer as the summer progresses. We are concerned that the GCDAMP is conducting an optional experimental release that increases the risk of smallmouth bass establishment which may put ESA-listed species at risk. Based on our review of the Tech Team report and GCMRC's Technical Analysis of comments received from the P&I Team members, we recognize the size of the effect of continuing the bug flow experiment may be small, but the directional arrow of likely effect admittedly points towards providing some level of benefit to young of the year smallmouth bass. This is especially concerning now that smallmouth bass have successfully spawned below Glen Canyon Dam, and additional young of the year smallmouth bass were recently found in the slough as late as the last week of July 2022. The cumulative effect of additional warming and nearshore stabilization of nursery habitat from this experiment is likely to contribute to young of the year smallmouth bass survival to some degree. We agree with the PI Team's assessment that implementing the bug flow experiment under these warmwater conditions only increases the risk of smallmouth bass becoming established below Glen Canyon Dam.

We appreciate the modeling by experts at GCMRC, however lacking critical data in our system we can only speculate how much risk it might be to continue this experiment. We do not believe that it is zero, but we also recognize that numerous other factors are contributing, perhaps more strongly than the experiment itself. The argument can be made that even if we stop the bug flows experiment, we are still likely to have smallmouth bass establish in Grand Canyon – and this is true. The implementation of bug flows may not be the main driver, yet should we be taking an action that makes establishment more likely? That contributes to a cumulative effect?

The approach that seems more prudent would be to take reasonable measures to make the river more inhospitable to smallmouth bass and other nonnative fish that may come through the dam under these warm release conditions. Looking back at this program, the primary objective of past steady flow experiments was to increase the survival and growth of young of the year warmwater fish by stabilizing and warming nearshore nursery habitat (2000 Low Summer Steady flow, 2009-2012 Fall Steady Flow, LTEMP Low Summer Flow). Backwater warming of as much as 13.0° C over mainstem temperatures was recorded during the 2000 LSSF (Ralston 2011¹). We do not have a calibrated measure to know how much additional warming and habitat

¹ Ralston, B.E., 2011, Summary Report of Responses of Key Resources to the 2000 Low Steady Summer Flow Experiment, along the Colorado River Downstream from Glen Canyon Dam, Arizona: U.S. Geological Survey Open-File Report 2011–1220, 129 p. <https://pubs.usgs.gov/of/2011/1220/of2011-1220.pdf>

stability would begin to benefit young of the year warmwater nonnative fish, but Korman and Campana (2009)² found increased growth in rainbow trout otoliths after just 1 day of steady flows. Without additional data, it seems likely that steady weekend flows could benefit smallmouth bass, and might contribute to increased growth and likelihood of overwinter survival. Bestgen and others in the Green River have shown increased temperatures and growth rates as a substantial factor in overwinter survival.

It has also been hypothesized on several recent calls that fluctuating flow releases might entrain more warmwater nonnative fish through Glen Canyon Dam than steady flow releases. However, this assumes the steady release is always lower than the peak discharge of the fluctuating flow. As part of the bug flow experiment, water is moved from the weekend to the weekday resulting in a higher weekday peak discharge than what would have occurred under normal operations. If this hypothesis is true, then the bug flow experiment could be increasing entrainment of warmwater nonnative fish through the dam over what might have occurred under normal operations.

Another reason for continuing the experiment this August was the potential benefit of increased gross primary production (GPP) might have for native fish. Deemer et al., 2022³ found that the benefit of low weekend steady flows to GPP only occurred under very clear-water releases. The Paria flooded on July 26, 28, and 30, 2022. There will be no additional benefit to GPP for the rest of this year in continuing the experiment.

There are also discussions currently underway to consider using bypass to cool the river, yet shouldn't we first consider stopping some of the activities that may be contributing to our problem? We can do the bug flow experiment again sometime in the future when the risks are not so great. Stopping the experiment doesn't have a major impact on our resources of concern, but not doing everything we can to deter the invasion of smallmouth bass in Glen Canyon and the other warmwater nonnative fish recently found in the Grand Canyon will have sustained and negative consequences for the Program.

We recommend that the bug flows experiment be stopped for this year. In addition, we should consider other actions to make the river less hospitable for nonnative fishes including increased fluctuations, reduced minimum flows, and other flow options that decrease the stabilization of nearshore nursery habitat for nonnative warmwater fish.

² Korman, J. and S.E. Campana, 2009, Effects of Hydropeaking on Nearshore Habitat Use and Growth of Age-0 Rainbow Trout in a Large Regulated River, Transactions of the American Fisheries Society 138:76–87
https://www.usbr.gov/uc/progact/amp/twg/2009-03-16-twg-meeting/Attach_18.pdf

³ Deemer, B.R., C.B. Yackulic, R.O. Hall Jr, M.J. Dodrill, T.A. Kennedy, J.D. Muehlbauer, D.J. Topping, N. Voichick, and M.D. Yard. Experimental reductions in subdaily flow fluctuations increased gross primary productivity for 425 river kilometers downstream. PNAS Nexus 1, no. 3 (2022): pgac094.

WYOMING

P&I Team - The recent finding of juvenile smallmouth bass in the Slough and in the area just downstream of the dam is a major concern to Wyoming and is one of the Bug Flow offramp triggers to start this conversation. If a population of SMB were to become established in Glen Canyon and the Grand Canyon, it would likely be a very detrimental impact to the current fish species that we have spent much time and millions of dollars to protect and improve. Our concerns: 1) there is a small chance, per the technical report, that the Bug Flows could lead to SMB establishment. Now, since juvenile SMB have been found, and that spawning of SMB is likely occurring, any potential benefit to the SMB, no matter how small, is too high. 2) Steady flow experiments (like the bug flow experiment) will likely increase temperatures in the near shore environments where spawning would occur, temperature being one of the two major factors contributing to SMB establishment. There appears to be some uncertainty in whether there is enough time for spawning to occur during the steady flow periods, per the conversation in the P&I meeting on 7/14. Here, this uncertainty is not worth the high risk of additional spawning to occur. 3) While there is a concerted effort to search for SMB, there have been multiple sightings, one of which may indicate a male guarding a nest. While some of these are not confirmed, we feel it is not worth the risk to continue with an experiment that may provide small advantages to the SMB, while we spend time documenting the problem. Based on these reasons, we feel the Bug Flow experiment should be stopped immediately.