07 June 2023

Dear Editor Michaletz and review team,

Thank you for your review of our manuscript (UJFM-2023-0050, named “Evaluation of shoreline rotenone application to control Largemouth Bass recruitment in small impoundments”) submitted to *North American Journal of Fisheries Management*. Comments from the review team helped us make improvements to the manuscript, which we describe in point-by-point responses below. In revising the manuscript, we enabled the Track Changes feature to demonstrate the changes we made for clarification. We also included a clean copy of the revised manuscript (i.e., no Track Changes). In our point-by-point responses, references to specific lines refer to the Track Changes version (with red, revised text visible) unless otherwise noted. We also made minor editorial revisions to the manuscript in accordance with comments from a required internal USGS review.

We are excited about the information presented in this manuscript and believe it will be of great interest to *North American Journal of Fisheries Management* and its readership. We thank all members of the review team for the time and consideration in reviewing our work. We appreciate the constructive feedback we received and hope that the revised manuscript provides the needed clarifications requested. Please feel free to contact me if I can be of further assistance.

Sincerely,

Tyler Steven Coleman

**Reviewer 1**

Reviewer 1, Comment 1: One glaring question is why the decision was made to separate “small” and “large” impoundments? Given that this was a subjective cut-off, why not combine to increase statistical power? This question was really hammered home in the methods that noted all instances of poor mixed-model performance associated with few values for large impoundments. If there was an objective reason to separate at 33 ha, that should be listed in the paper. A case could be made that all impoundments < 40 ha are functionally considered “small” (Neal and Willis 2012). This criterion could allow a single size group and only omit Lee County Lake from analyses (or keep it with an amended definition of small). Alternatively, the five impoundments > 11 ha could be omitted from this manuscript if the focus was observing the effects of the treatment on impoundments ≤ 10 ha (Line 87). One of these approaches would clean up a lot of seemingly repetitive findings and verbiage for describing both small and large impoundment models and responses. This is particularly notable in the methods when sample size was too small to allow a random effect (lines 198, 201-202,213-214, 217). If an impoundment size effect question existed, perhaps modeling any/all of the response variables against surface area would address that. A two-dimensional Kolmogorov-Smirnov test could also be considered to see if there was a critical impoundment size cutoff where shoreline rotenone failed to elicit the expected response.

Here

Reviewer 1, Comment 2: The sampling schedule, as presented, was confusing to me. I found myself reading and re-reading trying to figure out when and how these populations were sampled. Perhaps rereading through these sections with a critical eye toward improving clarity is warranted.

Here.

Reviewer 1, Comment 3: Line 15: Consider replacing “would need to” with “should.”

Great suggestion. We made this change.

Reviewer 1, Comment 4: Lines 44-45: Consider moving all citations to the end of the sentence for ease of reading.

We made this change.

Reviewer 1, Comment 5: Lines 46 and 47: What does productive mean in these instances? What makes a sport fish productive? What makes small impoundment habitat productive?

Great questions regarding productivity. We originally included an entire sentence dedicated to Largemouth Bass and Bluegill productivity in terms of how many eggs they lay per pound of body mass. However, we realized this sentence was unnecessary and tried to simplify it and combine it with this sentence. We have removed this confusion from this sentence. The following “productive small impoundment habitats” term was used in correlation with the previous use of the word productive. We believe no meaning is lost and only clarity is gained when removing “productive” here again. Thank you for this.

Reviewer 1, Comment 6: Lines 76-77: It’s intuitive that standard hook-and-line sampling is inefficient at catching age-0 Largemouth Bass but not so much for electrofishing. A citation here would be helpful.

We added citations. Thank you for helping us clarify this.

Reviewer 1, Comment 7: Line 91: I’m not familiar with the study locations, but I’m curious if surface area is a good proxy for littoral area? In other words, are these small systems all effectively littoral area? There might be value in examining response as a function of littoral area rather than surface area if the two aren’t related.

Great questions. For the “large size” small impoundments, this is an excellent recommendation that we will keep in mind. The large size impoundments potentially had different littoral zones due to islands, fingers, and other shallow-water nurseries throughout the impoundments. However, with the removal of the “large sized” small impoundments, the remaining small impoundments are all extremely similar farm ponds where only the circular shoreline is the littoral area. Therefore, surface area and littoral area are highly correlated.

Reviewer 1, Comment 8: Lines 104-107: This sentence is clumsy. Perhaps break it up to more clearly say when and how the ponds were sampled and when rotenone was applied. Also, there’s mention of electrofishing but not seining? Maybe the best option would be to provide more general information…” sampled with a suite of fish sampling gears”. Regardless of the approach, this could use some increased clarity.

With the removal of the large size small impoundments, we hope this portion of the manuscript is much clearer now. Thank you.

Reviewer 1, Comment 9: Lines 113-116: This information would be better suited for the introduction.

We agree. Thank you for this.

Reviewer 1, Comment 10: Line 122: What does the measurement “210,920 L/m2” refer to? If it’s an application rate, it seems very high. By my math, that’s about 225,000,000 gallons/acre. Fun aside, I’m not sure why this measurement would be associated with a spray wand.

Your math is correct! This measurement was supposed to represent the application rate of the wand we decided to use. We corrected this measurement to represent the wands functionality more accurately.

Reviewer 1, Comment 11: Lines 127-128: Typical rotenone applications are measured by ppm or ppb. Although 0.5 L per 90 m of shoreline is also a concentration, it’s hard to gauge how much rotenone was actually applied. I’m curious if this represents 2 ppm in the littoral area? 10 ppm? Is there a way to report how much was applied in a way that relates to other studies?

Thank you for this comment, however, we reported our 0.5 L rotenone per 90 m of shoreline to be a direct comparison of the McHugh (1990) application of 1 L rotenone per 200 m of shoreline. Therefore, we feel this is a fair representation as this method relates to this study. Additionally, other studies report concentrations as 1 mg/L or in total gallons applied to a study area (e.g., Finlayson et al. 2010; Billman et al. 2012, Fried et al. 2018).

Billman, H. G., C. G. Kruse, S. St-Hilaire, T. M. Koel, J. L. Arnold, and C. R. Peterson. 2012. Effects of rotenone on Columbia Spotted Frogs *Rana Iuteiventris* during field applications in lentic habitats of Southwestern Montana. North American Journal of Fisheries Management. 32:781–789.

Finlayson, B., W. L. Somer, and M. R. Vinson. 2010. Rotenone toxicity to Rainbow Trout and several mountain stream insects. North American Journal of Fisheries Management. 30:102–111.

Fried, L. M., M. C. Boyer, and M. J. Brooks. 2018. Amphibian response to rotenone treatment of ten alpine lakes in Northwest Montana. North American Journal of Fisheries Management. 38:237–246.

Reviewer 1, Comment 12: Line 154: embedded instead of imbedded?

We made this change.

Reviewer 1, Comment 13: Lines 191-218: See earlier comments about sample size and small/large impoundments. This verbiage is necessary as the paper stands, but it really bogs things down for the reader.

Clarified thanks to the changes to the manuscript described above. Thank you for this comment.

Reviewer 1, Comment 14: I really struggled to get through the results because there are so many models to interpret. Like my comment above, this is needed for the current structure, but I’d sure consider getting rid of the small/large to cut the methods and results sections in half.

We made this change. We believe the manuscript is much cleaner now thanks to these changes.

Reviewer 1, Comment 15: Line 311: Here’s another example of the different sizes of small impoundments creating unnecessary confusion.

Confusion no more thanks to the removal of large size small impoundments.

Reviewer 1, Comment 16: Line 312: Consider replacing “bream” with Bluegill or something similar.

We made this change.

Reviewer 1, Comment 17: Lines 367-372: Kudos to the authors for this. I raised my eyebrow at the survival index upon first read but it grew on me in subsequent reads. This is a nice job of recognizing the limitations.

We appreciate the comment and while we see value in the survival index, we wanted to make sure to acknowledge its limitations.

Reviewer 1, Comment 18: Line 409: I’m not sure the efficacy of shoreline rotenone on reduced bass recruitment as a function of surface area was assessed in this study? To my eye, there was a somewhat arbitrary grouping of small and large small impoundments that were analyzed separately. Examination of bass response to similar treatments using surface area as a continuous predictor would allow this comparison.

Now that we have removed the large size small impoundments, we agree that this objective no longer exists. Like we mention above, the reason we divided the small impoundments the way we did was because we had one grouping of small farm ponds and another grouping of ADCNR managed lakes. One of our main objectives in the proposal for funding was to observe if there was a treatment effect in small farm ponds compared to the larger state managed lakes. We could not use size as a continuous predictor because of the groupings of sizes of our small impoundments (i.e., the small impoundment surface areas were not normally distributed across our study sites). The study was designed to focus on two separate groups: (1) small farm ponds and (2) large state lakes.

Reviewer 1, Comment 19: Table 1: Consider rewriting this caption to omit the (c.f., “control”). Maybe “c.f.,” is commonly used but I’ve never seen it. Also considering organizing these differently. As it stands, it seems like years sampled is the most important variable. I’d consider either ordering by size or years treated.

We removed “c.f.,” for clarification. Reorganizing was a great idea; we reorganized the rows by years treated. Thank you for this.

Reviewer 1, Comment 20: Consider combining figures 2 and 3 and figures 4 and 5.

With the reduction of figure complexity due to the removal of large sized impoundments, we felt this was unnecessary at this time.

Reviewer 1, Comment 21: Figures 7, 8, and 9 left me with more questions than answers. Are these figures necessary? I can’t figure out what all of the lines mean if they are just showing temporal trends. Shouldn’t there only be treated and untreated (two lines) in each panel? The Figure 7 caption introduces more confusion than I suspect was expected. Maybe a table would be better?

Here

**Reviewer 2**

Reviewer 2, Comment 1: Suggest writing scientific names for Largemouth Bass and Bluegill in abstract?

Thank you for this. We added scientific names in the abstract and replaced “bass” with “Largemouth Bass” throughout.

Reviewer 2, Comment 2: Line 18: You specifically say “in 20 Alabama small impoundments”, but one of the largest components of your study is the comparison of small vs. large impoundments. You don’t mention any kind of impoundment size in abstract. You even mention small and large in the Management Implications. I know you defined them in your Study Site, but I think your abstract should address two classes considering there was so much emphasis in your analysis, results, and discussion.

Great comment. We think the lack of exclamation on the large and small size impoundments at the beginning of the manuscript and in the abstract contributed to the confusion of why we separated them in the study design and analyses. However, we removed the large sized impoundments from this manuscript in hopes to increase the clarity of this study.

Reviewer 2, Comment 3: Line 66: I’d change “in bass in some systems” to “in bass at some systems”

We changed “in bass in some systems” to “of bass in some systems.”

Reviewer 2, Comment 4: Line 67-70: With the statement of bass fecundity leading into the overcrowding and reduced growth potential, I’m thinking that overcrowding and reduced growth would impact fecundity, but not sure I’d go with the other way as much. A lot of that may depend on post-hatch survival. Not saying to take it out, but questioning if it should be here or is needed. I think you can go straight into catch and release over last 30 years, how that may have impacted numbers based on fishing mortality, how it can change composition of species and then ways to maintain balanced populations.

We appreciate this comment, and we clarified this sentence in hopes that it is read as a support sentence. Our thought here is we are saying due to catch and release, we see increased bass densities. In addition to these increased densities, bass experience high annual spawning rates, continuing this vulnerability pattern to overcrowding and density-dependent growth reductions.

Reviewer 2, Comment 5: Why is < 10 ha important to mention on line 87? I was looking for that in methods and you have small (< 12 ha) and large (> 33 ha) impoundments. Seems like you are making an argument in Intro about it not being done and there being a need, but then for your methods, you aren’t using that size qualification.

With the removal of the large size small impoundments, this is now less critical. We changed the value to be ≤11 ha. This was essentially the motivation for the separation of large and small size small impoundments. As in, large size small impoundments (>24 ha) have been evaluated, but smaller sized small impoundments have not.

Reviewer 2, Comment 6: I’m a little surprised not to see Davie et al. (1982) cited anywhere. Prey-dependent recruitment of Largemouth Bass: A conceptual model. It talks directly at use of rotenone and seems very relevant to this paper.

Thanks for the comment! Originally, in a more extended draft, the Davie et al. (1982) paper was referenced with a sentence in the introduction. But the Davie et al. (1982) paper uses rotenone for sampling, not for a method of recruitment reduction to effect densities or growth. Other than that, it does not bring much original thought that the Swingle, Miranda, and Willis references do not already cover. However, we did give it a rightfully deserved home on L74 thanks to their management implications section.

Reviewer 2, Comment 7: Overall, the Introduction is extremely well written. Really good job. I actually tried to be knit picky with some of my comments. It’s really well written.

Thank you for your comments. Your comments, in addition to all members of the review team, helped improve the introduction.

Reviewer 2, Comment 8: Lines 135-137: I’m a little lost with this sentence. I get the seining of treated impoundments at sunrise, but not so much the control impoundments immediately after you treated the treatment impoundment? You mean the same exact day and you rotenone an impoundment, you went to another and seined a control?

Yes. We added four words to the sentence to help clarify this. For all treated impoundments, pre-treatment seines were pulled on days 1 and 21 (then the impoundments were treated) and post-treatment seines were pulled on days 2 and 22. For all control impoundments, seines were pulled on days 1 and 21 and days 2 and 22. Seine pulls for days 2 and 22 were always at the same time of day as days 1 and 21 to minimize any time-of-day effects on catches.

Reviewer 2, Comment 9: In Methods, a lot of your analysis description gets redundant. You mention multiple times throughout, and sometime multiple times in one paragraph, that you could not use a random effect of year because of our sample size (Table 1) resulting in singular fit – and a fixed effect rotenone to meet assumption of normality. It just seems to add a bit to the overall methods that I don’t think is necessary to say over an over again. Why not say what analysis you did and say that type of statement once if you had to do the same thing over and over again for growth, CPUE, recruitment, etc.? If it changes for one because of sample size, then be specific with that one.

With the removal of large size small impoundments from this manuscript, we believe the methods and results have become much cleaner and removes most of the redundancy. Thank you for this comment.

Reviewer 2, Comment 10: Line 251: Do you think you need to mention the “even though an additional reduction was observed”? It’s not significant.

This sentence in the results is now removed due to the removal of large size small impoundments from this manuscript.

Reviewer 2, Comment 11: Results: I’d like to see a Figure reference as soon as you give the first result, or at least at the end of that first sentence that is related to a figure. I think this starts off in the first paragraph, when you give your first stats. You follow up it up with the sentence “In other words….”, and reference the figure, but I’d like to see it from the start. For me, this became really noticeable when you get down to your paragraph dealing with Figure 6. You mention all of these results, but don’t reference the Figure until the end. I suggest changing throughout.

Here

Reviewer 2, Comment 12: Just thinking about how to reduce some of the redundancy, when you get to Bass MLA-1 and you don’t find any significant difference between one versus two years of treatment for both small and large impoundments, why not make that one sentence? Something like “However, we did not find a significant difference between bass MLA-1 between one versus two years of treatment for small (F1,24=19.15: p=0.69) or large impoundments (F1,9=3.83; p=0.84; Figure 7).”

This redundancy is eliminated thanks to the removal of the large size small impoundments from this manuscript.

Reviewer 2, Comment 13: Lines 332-335: I’m glad you mention this here. I thought about that immediately considering it is summer and you have new YOY Bluegill coming in throughout the study, but probably not so many bass.

Thank you for this comment and acknowledgment.

Reviewer 2, Comment 14: Paragraph 347-357: Anything you can reference here for comparison? I know you mentioned not much work being done on bass recruitment in impoundments <10 ha, but may be good to have something to bounce off of.

With the reorganization of the manuscript, this paragraph changed, and we believe now more accurately represents what we observed and allows us to reflect on what researchers need to think about moving forward using this management approach. As far as a citation supporting what we experienced when applying the shoreline rotenone application in more complex littoral habitats of the large size small impoundments, we are unaware of literature to help support this. We did add a citation in support of variable electrofishing for bass.

Reviewer 2, Comment 15: Table 1. – I’m guessing c.f. is Confer? Not sure I’d use it here. Maybe just have “and year(s) of shoreline roteline application, if any.”

We made this change. Thank you.

Reviewer 2, Comment 16: Figure 6: Consider going 3 to 5 on y-axis for and keep decimal place out like others. I guess you would only have 3, 4, and 5 on y-axis, but makes it more the same as other figures.

In your next comment, you tell us to keep the decimals. If so, should we keep the decimals on this y-axis? We made the figure with only 3 and 4 on the y-axis (if we expand to 5, there is a lot of extra white space), and the y-axis looked very bare. We are happy to change the y-axis scale.

Reviewer 2, Comment 17: Figure 7: Was going to suggest same thing with getting rid of decimals, but your scale is much shorter. May just keep it as is.

We made the y-axis scale only include whole numbers, but like above, the y-axis felt and seemed very bare. Again, we are happy to change this if desired.

Reviewer 2, Comment 18: Figure 8: Keep the y-axis scale the same for Small and Large Impoundments.

Thank you for catching this! We are sorry for not having the same y-axes for both of those plots within the figure. The good news is the large plot is now gone anyways.

Reviewer 2, Comment 19: Overall, I think this paper is really well written and provides good information.  There is definitely a bit of lengthiness to it and some areas (methods and results) where I feel like there is redundancy and can be shortened.  For example, I’m not sure it’s necessary to provide the exact details of how you applied rotenone, and make statements of marking seine sites with a GPS to ensure consistency over time, or go to into detail with how you aged fish.  I think those are all types of things I’d expect to see in a report or thesis, but not sure they are necessary here.  There are other areas where the same type of statement for analysis was mentioned multiple times.  I pointed some of that out and would figure out how to reword to say once.  I think the figures really speak for themselves and enjoyed reading this and trying to put thought into it.  I’m not sure what all species are in the impoundments, but would have liked to see more information than just bass and Bluegill.

Thank you for all your comments. With the addition of your comments, and the other members of the review team, this manuscript is in much better shape. Thanks to the omission of the large size small impoundments (discussed above), we believe the manuscript is much easier to comprehend. We left in the details describing how we applied rotenone and aged fish in hopes that if someone wants to use this method in the future, it will be easy to mimic exactly what we did. We removed some of the extra wordiness you suggest, and again, this manuscript becomes much more digestible without the redundancy of small and large size small impoundments throughout. Regarding species, we targeted impoundments with only Largemouth Bass and Bluegill. We clarified this in the manuscript as well.

**Editor**

Editor, Comment 1: The review team provided many helpful comments to improve your paper.  In particular, the review team and I strongly suggest that you eliminate the small and large impoundment categories.  The review team provided some ways to do this but because the study impoundments are really all small impoundments, I suggest combining them all together.  This would eliminate a lot of redundancy in your paper and the problems you had with some of your analyses because of low sample sizes.  Additionally, you provide no justification for separating these impoundments into small and large.

Here

Editor, Comment 2: In the abstract, please provide scientific names for each species upon first mention.

We made this change.

Editor, Comment 3: Throughout the paper use Largemouth Bass not bass.

We made this change.

Editor, Comment 4: Line 46. I think it should be fishes not fish.

We made this change.

**Associate Editor**

Associate Editor, Comment 1: Most importantly, as Reviewer 1 indicated, the division between "large" and "small" impoundments adds a seemingly unnecessary convolution to the paper which could be resolved in a number of different ways. Given the title and focus of the paper, you could cut the larger waterbodies entirely out without losing the message and lessons learned. I believe it would simply the methods and reduce the redundancy of results. Alternatively, you could use surface area as a continuous variable instead of a binary categorical variable. I also thought the suggestion of Reviewer 2 was good: to use shoreline length instead of surface area, if you believe the driving factor may be littoral habitat. Regardless of how you choose to address this, please ensure your approach to handling larger impoundments is well documented and justified, and simplifies the methods and results sections.

Here

Associate Editor, Comment 2: The large/small division contributed a good portion of the wordiness and redundancy in the paper, so addressing that should improve that substantially. However, be sure to go over the resulting revision again to reduce wordiness. If a set of variables are treated the same way, with identical modeling approaches, I suggest indicating that rather than repeating near-identical descriptions of analyses. Both reviewers provided good advice regarding areas that could be reduced.

Here

Associate Editor, Comment 3: What concentration of rotenone was targeted? The 210,920 L/m2 is confusing, but you are very clear about 0.5 L per 90 m shoreline. For anything standard, you could simply reference the AFS Rotenone Manual and label, and reduce the text. Anywhere you deviated from the Rotenone Manual should be documented here.

Thank you for catching this. We corrected the wand rate thanks to Reviewer 1’s Comment 10. We wanted to give the wand pressure rate so if someone wanted to use this method, they could use the same wand (300 psi or 21.092 kg/cm2). We documented our calculations and application design because of the uniqueness of this method, which is not like the AFS Rotenone Manual.

Associate Editor, Comment 4: Lines 233-237: Differences in catches were similar? Reword

We made this change.

Associate Editor, Comment 5: Lines 243-254: So Bluegill were or were not affected? What was the difference between application and treatment?

Treatment is whether the impoundment received rotenone or not. Application is day 1 and day 2 versus day 21 and day 22. For both Largemouth Bass and Bluegill, regardless of application (day 1 or day 21), the same immediate treatment effect was observed. We believe this is easier to understand now without the redundancy from the different size small impoundments.

Associate Editor, Comment 6: Figure 4 and Lines 250-262: Should not present results like a 71% reduction if not significant.

We believe it is important to mention that these large differences were observed. This is a good example of where something is not statistically significant, however, the result is still biologically relevant and should be acknowledged and not ignored.

Associate Editor, Comment 7: Figure 8: No differences, no figure needed

We did find significant differences in Largemouth Bass recruitment between the controls and one and two years of rotenone treatment (L…)

Associate Editor, Comment 8: Figure 9: No differences, no figure needed, if wanted you could include as Supplementary Material but not really relevant finding

Figure 9 is the pair to Figure 8. With the removal of large size small impoundments, we decided to combine Figure 8 and 9 as they both are electrofishing CPUE. The fact that we find no statistically significant rotenone application effect on Bluegill electrofishing CPUE is an extremely relevant finding, and pairs well with the fact that we did see a rotenone application effect on age-1 Largemouth Bass electrofishing CPUE.

Associate Editor, Comment 9: Line 312: Replace the term bream with scientific terminology

We made this change. Reviewer 1 in Comment 16 made a similar recommendation.