28 August 2015

Dr. Hollocher,

Enclosed is a modified version of our manuscript entitled “Age, Growth, and Size of Lake Superior Pygmy Whitefish (*Prosopium coulterii*).” The manuscript was modified based on the suggestions of Associate Editor Dr. Pyron, two anonymous reviewers for the journal, and our further proofing of the manuscript. Each change to the manuscript or our rationale for not making changes suggested by the reviewers are detailed below in comment-by-comment format. We hope that you will find our edits both easy to follow and acceptable.

**Thank you for your continued consideration of our manuscript. We look forward to your response regarding the suitability of the revised manuscript for publication in the *American Midland Naturalist*. Please contact me if you have any questions or concerns related to the manuscript or our responses to the reviewer’s suggestions.**

**Respectfully,**

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Dr. Derek H. Ogle

Professor of Mathematical Sciences and Natural Resources

**Response to Associate Editor’s Comments**

(First line numbers refer to the Stewart et al 15 AE track changes.docx document. Trailing line numbers refer to the newly submitted manuscript.)

Accepted all suggested edits except for the following:

*Lines 12-14 –* The suggested changes are not consistent with our sampling process. We measured the TL for all fish collected. We then recorded weight and sex and extracted scales and otoliths from a subsample of those fish. The suggested changes implied that we recorded weight and sex for all collected fish, which is not true. [*Lines 12-13*]

*Line 130 –* We prefer to keep “most” in front of “obvious.” Removing “most” implies that the marks were clearly obvious in that region and that was not always the case. Leaving “most” suggests that the marks were not always clearly obvious, which was the case. [*Lines 116*]

**Response to Reviewer 1’s Comments**

(First line numbers refer to our original submission … which are the line numbers that the reviewer referred to. Trailing line numbers refer to the newly submitted manuscript.)

*Major Comment 1* – We moved the weight-length relationship results paragraph to the end of the results to make a parallel organization with the introduction. We kept a fish size section in the results as it is important to characterize the lengths of fish observed prior to discussing growth. Thus, the results now has four sections – 1) Age, 2) Size, 3) Growth, and 4) Length-Weight relationships.

*Major Comment 2* – As the reviewer noted, the extra sums-of-squares method and the information criterion method (e.g., AIC) are both valid model selection methods (as is the likelihood ratio test). However, we disagree that the IC methods will be more familiar to readers. The extra sum-of-squares test is simply an analysis-of-variance. In addition, the likelihood ratio test has been put forward by Kimura (1980) for testing differences in VBGF parameters among groups. Kimura (1990) later showed that the extra sum-of-squares and likelihood ratio tests are functionally equivalent. Thus, our extra sum-of-squares tests will be familiar to readers who are familiar with analysis of variance and to readers that are familiar with the statistical literature on comparing VBGF parameters. Furthermore, we feel that using IC is fundamentally in contrast to the hypothesis/significance testing methods used elsewhere in the paper. Finally, we did not defend our use of the extra sums-of-squares tests in the manuscript because we feel that doing so would distract the reader.

*Major Comment 3* – We added the last paragraph in the discussion. This required adding the Vecsei and Panayi (2015) reference. [*Lines 276-285*]

*Line 10* – Done. [*Line 10*]

*Line 23* – Fixed. [*Line 23*]

*Line 62* – Fixed. [*Line 62*]

*Line 68-70* – We agree with the reviewer’s comment. We have attempted to address this problem by removing the last phrase (“to determine if growth of Pygmy Whitefish from Lake Superior changed in 60 y”) of this sentence. This change clarifies that we only compared the 1953 and 2013 sampling events. Please also see our response below to the related comment for Lines 274-276. [*Lines 68-69*]

*Lines 85-87* -- Trawl distance was determined using the ship’s navigational computer system (Computerized American Practical Navigator, [www.thecapn.com](http://www.thecapn.com)) that relies on a geographical positioning system (GPS). This is standard equipment for a ship of this size. We do not think it needs to be described in the paper, similarly as depth is not described as being determined using a fathometer or trawl time is not described as having been measured using the ships computer.

*Lines 164-166* – The proper fitting of VBGFs require young and old fish so that L1, L2, and L3 (i.e., using the Francis parameterization) can be reliably estimated. We could not determine the sex of age-1 fish, so if these fish were excluded from the analysis, then young fish would not be present to help fit the VBGF for both sexes. We do not have data on the sex ratio of age-1 Pygmy Whitefish as the sex of age-1 fish cannot be determined for Pygmy Whitefish and other Coregonids in Lake Superior and elsewhere. Our method of assigning sex to age-1 fish would not affect the overall results of the VBGF model fitting unless the sex ratios were dramatically skewed such that the randomizations would result in a small number of age-1 fish from one end of the distribution being allocated to one sex or the other. It is unlikely that the sex distribution for age-1 Pygmy Whitefish is strongly skewed and that an extreme randomization would occur. We could perform a sensitivity analysis that addresses this question but we believe that that analysis is beyond the scope of this paper. Finally, we feel that our method for anchoring the left-side of the VBGF is more defensible (and less draconian) then setting model parameters to constants as has been done in the literature (e.g., see Cailliet et al (2006)).

*Lines 170-176* – The reviewer noted that APE was only found in Table 1 and was not mentioned in the text. As APE is a constant proportion of ACV, it is a redundant measure. Given this and the reviewer’s comment we removed APE from the manuscript. This required removing a statement in the methods (Lines 135-136), a statement in the label for and a column in Table 1, and the Beamish and Fournier citation. We moved the sentence that summarized ACV to the second sentence in that paragraph to have a parallel construction with the table (the reviewer suggested changing the table, but we have accomplished the same end result). [*Lines 169-170*]

*Line 183* – Done. [*Line 181*]

*Line 191* – Done. [*Line 189*]

*Line 197-198* – Done. Required a significantly re-organized sentence. [*Lines 193-196*]

*Line 197 and elsewhere* – Done.

*Line 203* – Done. We also had an error in our back-transformed intercept (used base e instead of base 10). Thus, the back-transformed intercept was not within the intervals provided by FishBase. We have corrected the text to reflect this corrected result. [*Lines 213-215*]

*Line 205* – Modified sentence but somewhat differently than the reviewer’s suggestions. Deleting “quite” as suggested by the reviewer does not effectively communicate that there was high variability in assigned ages within length bins. [*Line 198*]

*Line 215* – Done. [*Lines 208*]

*Lines 227-231* – Fixed. It appears that our intent was not clear with the last sentence in this paragraph. The paragraph is about problems estimating the age of fish with scales and how that is likely related to crowded circuli at the scale margin. The last sentence is intended to provide credence that somatic fish growth is slow and thus growth of the scale would be slow and would result in crowded circuli. We have modified the start of the last sentence to more directly tie the rest of the sentence to the concept of crowded circuli and, thus, the topic sentence for the paragraph. This should address the reviewer’s concern. [*Lines 228-230*]

*Line 232-239* – We do not feel that this paragraph needs to be augmented per the reviewer’s request. Our intent here is to be as transparent as possible about the problems that we encountered while estimating the age of these fish so that the reader can be cognizant of this while interpreting our results and planning future studies. We believe that the original paragraph accomplishes this intent.

*Line 260* – Done. [*Line 259*]

*Line 269* – Done. [*Line 268*]

*Line 270* – We did not change this. The actual values are in the results and they depend on the age examined. The general statement that we use seems warranted for the discussion.

*Lines 274-276*. Again (please also see our response to Lines 68-70), we agree with the reviewer’s comment. We have re-written the last sentence primarily by changing the word “change” to “differ” to more clearly articulate that we compared two sampling events. We have attempted to say that these two events do not “differ” and do not make implied statements about whether any of the metrics have “changed” in 60 years. In other words, as the reviewer noted, the metrics could have changed without our two data points being different. We believe that the “differs” language is more accurate and addresses this concern. [*Lines 274-275*]

**Response to Reviewer 2’s Comments**

(First line numbers refer to our original submission … which are the line numbers that the reviewer referred to. Trailing line numbers refer to the newly submitted manuscript.)

*Line 289* – Fixed, changed “Norway” to “Sweden”. [*Line 298*]

*Table 3* – Done. We added the state/province information and a note that scales were used for all studies.

*Figure 1* – We added the Eschmeyer and Bailey (1955) sampling locations.

**Additional Changes per Our Review**

(First line numbers refer to our original submission … which are the line numbers that the reviewer referred to. Trailing line numbers refer to the newly submitted manuscript.)

*Throughout* -- Changed “von Bertalanffy growth model” to “von Bertalanffy growth function” and “VBGM” to “VBGF”.

*Throughout* -- Changed “coefficient of variation” to “average coefficient of variation” and “CV” to “ACV” when referring to precision of age estimates.

*Throughout* – Updated software version numbers to latest releases.

*References and throughout* – Replaced the Ogle (2015) reference to a draft chapter on a webpage to the in press (will be released in 2015) book by Ogle.

*Line 29* – Changed “but are” to “and”. [*Line 29*]

*Line 69*-70 – Added a reference to “Fig. 1” here given reviewer 2’s comment about wanting to see the Eschmeyer and Bailey (1955) sampling locations. [*Line 69*]

*Lines 85-88* – Added the italicized words in the following … “Trawls were towed across depth contours beginning in shallower water at *a speed of* approximately 3.5 km/h. The tows had a mean beginning depth of 41.8 m (range: 10.6-140.0), ending depth of 91.5 m (range: 37.6-156.0), and *the* mean distance covered *was* 1.77 km (range: 0.64-3.22).” [*Lines 84-87*]

*Line 124* – Removed “then” after comma. [*Line 123*]

*Line 175* – Changed “but only” to “and”. [*Line 173*]

*Line 188* – Fixed misspelled Eschmeyer. [*Line 186*]

*Line 261* – Changed “Tables 3 and 4” to “Tables 3,4” for consistency and per journal format. [*Line 258*]

*Line 270* – Added “(Tables 3,4)” at end of sentences to refer the reader. [*Lines 260*]

*Lines 299-300* -- Fixed hanging indent for Becker reference. [*Lines 306-307*]

*Figure 1* – Changed title to reflect modifications to the figure requested by Reviewer 2.

**References Mentioned in these Responses**

Cailliet, G. M., W. D. Smith, H. F. Mollet, and K. J. Goldman. 2006. Age and growth studies of chondrichthyan fishes: the need for consistency in terminology, verification, validation, and growth function fitting. Env. Biol. Fish., 77:211-228.

Eschmeyer, P. H. and R. M. Bailey. 1955. The pygmy whitefish, *Coregonus coulteri*, in Lake Superior. Trans. Am. Fish. Soc., 84:161-199.

Kimura, D. K. 1980. Likelihood methods for the von Bertalanffy growth curve. U. S. Fish. Bull/, 77:765-776

Kimura, D. K. 1990. Testing nonlinear regression parameters under heteroscedastic, normally distributed errors. Biometrics, 46:697-708.