OTG: This paper purports to provide an assessment the age and growth characteristics of Lake Superior Pygmy Whitefish (PWF) based on a single year of sampling taken broadly across Lake Superior.

DHO: --

OTG: This assumes that there is one homogenous stock/population of PWF in Lake Superior and that fish in all areas have similar age and growth characteristics.

DHO: Our analysis DOES assume that fish have similar age and growth characteristics (in the sense that we do not separate fish by capture locations or regions). However, our analysis does NOT assumed that PWF in Lake Superior are one stock or population (it is possible that there are multiple stocks, but age and growth characteristics do not differ among them).

OTG: Inserting page numbers and line numbers would be helpful for reviewers.

DHO: The JFE Guide does not offer advice on this. We added line numbers to the manuscript.

OTG: The Methods should be greatly condensed

DHO: See next comment and comments further below. However, we did examine the methods for ways to condense.

OTG: issues of comparing scale and otolith aging and multiple agers is old news.

DHO: I only partially agree with this statement. Some of the methods are moderately old (age-bias plot, CV, and APE) but alternative methods exist in the literature and thus we need to say which methods we used. Furthermore, the methods of symmetry for detecting bias are not relatively new (though the papers are relatively old) or well understood. Again, we do NEED to explain what methods we used.

We explained our bias detection methods (age-bias plots and symmetry) in one sentence and our measures of precision (in another sentence), with each sentence concisely referencing the relevant literature and the specific software used. I do not think that two sentences on these methods is “too much” explanation when one of the objectives in the paper is “age comparisons.”

See comments further below about referencing R functions.

OTG: I do find it interesting that the results of otolith aging were less reliable (repeatable) than scale aging.

DHO: This is interesting, but the results are mixed on this. When precision was measured by perfect agreement and the ability to reach a consensus age then otolith age assessments appeared less precise (slightly). However, when precision was measured by CV and agreement within one year the scales and otoliths were approximately equally precise.

OTG: Otolith ageing in this species is apparently messy (false annuli, missing annuli, pseudo annuli, etc.)

DHO: Yes, one of the points of our paper.

OTG: How experienced were the agers used in this study? Were they students? (yes) I suspect that experienced agers that do this for a living would have had fewer issues. I would be honest about the experience level of the agers.

DHO: The self-answered question about students is only partially true. One set of otoliths ages were by a student (TS) and another by me (DO). One set of scale ages were by TS and another by a student (DL). See further comments about training below.

I cannot see any place in the manuscript where we were dishonest about the experience level of the readers. We did not address this in the original manuscript (have now) because it is uncommon to do so except for papers that explicitly compare precision among readers with differing levels of experience.

OTG: I really doubt that “blind” aging techniques as blind as claimed. An experienced reader, upon seeing an otolith, would be able to gauge its relative age based just on the size of the otolith. An experienced reader should be knowledgeable of the difficulties in aging a particular species, and that knowledge is gained from non-blind aging, i.e., having as much biological information as available to understand the relationship between real annulus formation and the size/age of the fish. For example, knowing that a fish of a certain size in the context of a length-frequency distribution is likely to be 2-3 years of age and not 1 or 4+ years of age will be invaluable in correct reading of annuli. This process will aid in discriminating false and real annuli. Once the reader is trained through non-blind aging, “blind” aging is then done to avoid basing age estimates on information other than the otolith. A reader’s ability to correctly read otoliths should be verified by testing them with otoliths that have been aged by experts. Also, experienced agers apply a confidence level for each fish they estimate age for.

DHO: The ages that we used in this manuscript were aged “blind to any biological information related to the fish” as we clearly stated in the methods. Obviously the readers were not blind to the apparent size of the otolith or any other observations that they could make while looking at the structure.

In addition, there is an assumption here and in the previous comments that these ages were obtained without any training. We had a set of training scales and otoliths where we spent a great deal of time working out the procedures to the get the most clear and most consistent images possible, we consulted with more experienced age analysts on training structures (names of which you will recognize in the Acknowledgments), and we sent some structures to UWSP to help “validate” our age assessments against “expert” opinion. We wrestled with the “messiness” of these otoliths since day one and work very hard with a number of people to address this issue as much as possible. Your implication is that our results come from a relative lack of experience and I would argue that is simply not true.

We did not look at the length or the sex of the fish because I am a firm believer that doing so makes the analyst identify ages that meet their narrative of what the age should be rather than what information is discernible from the structure. This is a common and important problem in historical age assessments. I believe, given the variability in length-at-age for PWF that it was important to assess age from only examining the otolith or scale.

The LF were only useful in identifying 1, possibly 2, age-classes in any given year. Thus, length is not particularly helpful in identifying an exact age for PWF.

Thus, while our age assessments may not be perfect, it is not correct to imply that we did not do our very best, and an effort that is on par with many other studies of age and growth, to get defensible age assessments.

OTG: Resolving the problem of the missing age-1 annulus in scales is a good insight.

DHO: We agree.

OTG: Samples include fish from spring through mid-summer, which can inject additional variation in age-growth characteristics.

DHO: Valid point; included a comment on this in the discussion. Some studies will back-calculate a length at the last annulus. We did not reliably see plus-growth on our structures and did not have a reliable back-calculation model (especially for otoliths) and did not do that. We only compared to other studies that recorded length-at-capture at age rather than back-calculated lengths-at-age.

OTG: Statistical analysis is the typical *Tour de Force* approach now quite popular with the advent of R routines.

DHO: I don’t understand this comment. Statistical analyses were around way before R (see Bayes and LaPlace in the 1700s; Gauss in the early 1800s; Pearson and Gosset in the late 1800s and early 1900s).

OTG: The language in the methods is jargonistic to R

DHO: In what way? We do not do anything that is different than when a researchers says that used PROG GLM or PROC MIXED in SAS to do such-and-such an analysis. We are being transparent about our exact methods (which can, by the way, be completely seen given the open source nature of R, in contrast, for example, to JMP or Excel).

OTG: I would just state the statistical tests used and somewhere state that all statistical analyses were performed in R with such and such routines. As much as possible condense and simplify.

DHO: This is what we did, with the exception that we also state which routines (functions in R) are used in R which requires saying which package they are in and citing the authors of that package. I don’t see how this is too much for the reader to digest. More importantly this is in accordance with recent calls for more transparency and an increased ability to re-create the analyses in a paper (the trend towards “reproducible research.”)

OTG: The age-length key (Table 2) is a mess and readers should be cautioned about the reliability of the data presented. The inconsistencies point to problems and errors in aging fish and thus are not an accurate portrayal of age-length relationships. The VBGMs (Fig. 4) make sense, contradict the age-length keys, and are likely a more accurate portrayal of life history.

DHO: I agree that these are messy. However, this is part of the point of the paper. These results help demonstrate either the difficulties that we had ageing these fish (which we later support by discussing how others also had problems ageing PWF) or that these fish are quite variable in length-at-age or age-at-length (which is also supported later by findings in other studies).

It is the same data in the age-length key as in the VBGMs (with the exception that the ALK uses binned lengths). The apparent contradiction is related to the power of the statistical methods (multinomial models versus VBGM) as much as anything else.

OTG: It seems that the primary purpose of Figure 3 is to show a break in the size distribution between age-2 and age-3+ fish. If so, why show years other than 2013 (the year of this study)?

DHO: We are attempting to show that what is observed in 2013 is not a one year observation. For example, if we only looked at 2013 data, a possible explanation for the apparent break around 75-80 mm could be that a year-class is (largely) missing. Including the other years shows that this is a (relatively) consistent phenomenon that more fully suggests a separation of age-classes.

OTG: The distribution from 2008 shows what appears to be age-1 fish distinct from age-2 fish. Though that may be interesting, none of those fish were aged nor the subject of this study, nor were they captured in the same range of habitats of all other PWF in this study (they were captured at depths ranging from 2-15 m in the Apostle Islands by O. Gorman).

DHO: We acknowledge all of that and make it clear that they came from different sampling. However, these fish do provide some evidence, albeit with caveats, for our hypothesis about a missing first annulus. These fish are not absolutely necessary to form our hypothesis about a missing first annulus, but they do lend credence to it that might more strongly motivate future research.

Were those small fish from the 2008 sample preserved? If so, it would be interesting to age those fish.

OTG: For the life of me I can’t see the difference between Tables 3 and 4; they purport to show the same information based on the caption description. Table 4 is never mentioned in the results but mentioned in passing in the discussion.

DHO: Table 3 is for female and Table 4 is for female fish … I believe the version we sent you made this distinction (first word on second line of the caption). Lack of reference to Table 4 was an oversight on my part. Taylor corrected this when he converted the manuscript into the format of the journal. Thus, this is corrected in the current manuscript.

OTG: Is the only difference that means of observed sizes at age for “This Study” are based on VBGMs? If so, why are the cell values for other populations in the two tables different?

DHO: Not sure what you are referring to here? Does the fact that the two tables are for the different sexes address this question? Is your question that Table 4 does not have age 8+ and age 9+ rows? If so, we deleted those because they were all blanks (longevity of male fish is lower).

OTG: Table 4 shows evidence of regional effects on age-growth of PWF. In 1953 Isle Royale and Keweenaw PWF show different age-growth relationships for fish <age-5+; PWF in Isle Royale grow more slowly (as suggested in the text, 1 year must be added to other studies to render them comparable to This Study). The authors should consider partitioning their data by region to explore regional effects on growth of PWF.

DHO: We don’t have these data (i.e., we know where our fish came from but there are not enough from each location to allow any reasonable analysis). We could suggest this for further research.

OTG: Can the authors speculate as to why males grow so much more slowly than females after maturation?

DHO: Females generally mature one year later so I am not sure that the difference in growth after maturation is that strong. However, one might speculate that faster-growing males die young such that we are observing only the slowest growing males in the older age classes. More likely, though, is that the few older males that we did sample just happened to be small (sampling variability) and the “outlying” small male at age-6 brings the VonB line “down” which makes it look more asymptotic (and, thus, slower at the older ages).

OTG:

DHO: