AE: I found this study well-conceived and well-executed. Overall, I think this is a substantial addition to the ongoing scientific quandary regarding long-term poor recruitment of cisco, as well as a useful contribution that will aid in the rehabilitation of cisco more broadly. Please refer to the manuscript copies returned by both reviewers for detailed comments and address these comments in your response.

Reviewers' comments:

There is no reviewer #1.

Reviewer #2: In this paper, the authors describe the results of an analysis of the impacts of light conditions (specifically, light intensity) on the embryonic survival and development of two populations of cisco Coregonus artedi, one from Lake Superior's Apostle Islands and the other from Chaumont Bay in Lake Ontario. I found the paper to be well-written and the analyses to be robust. Moreover, I believe the authors' findings will be of interest to researchers and managers in the Great Lakes and beyond, particularly given the current high level of interest in the rehabilitation of coregonine stocks in the Great Lakes. As such, I believe this work will make a nice contribution to the literature following revisions. My comments are in the attached PDF file and are mostly minor.

Line 54-55: I recommend tempering this statement. There is evidence to suggest that recruitment can be set at later stages, particularly for freshwater fish (see, e.g., Houde 1994 ICES JMS 51:91-97 and Ivan et al. 2011 TAFS 140:1078-1092).

We prefer to leave the sentence unchanged. The topic of the sentence is year-class strength, which is different than recruitment. Most coregonines are sexually mature and enter the fishery around age 2-3, so yes recruitment could be set at later life stages. But, year-class strength and survival to age-1 is inherently and largely dependent on surviving through the first season of growth.

Line 65: “more stable” to “stabilization of” or “reduction of”?

Change to “stabilized”. There is evidence that water temperatures in the absence of ice cover can be colder than with ice due to more wind-driven mixing and interaction with cold air, so reduction of does not seem appropriate.

Line 69: “Sunlight (i.e., photoperiod)” - Not sure that this makes sense. Maybe just say "Photoperiod" or "Photoperiod (i.e., the period of time each day during which an organism is exposed to sunlight)" or similar?

Done. Changed to “Photoperiod”.

Line 79-80: remove “and” and replace “; with” with “, and”

Done.

Line 83: “light illumination” - Should probably clarify here -- e.g., do all of these studies deal with manipulations of light illumination during incubation?

Yes, all studies focused on light illumination during incubation. Changed to “manipulated light illumination during incubation”.

Line 88: change “responded” to “respond”

We prefer to maintain past tense throughout this sentence.

Line 93: change “If our hypothesis is supported, we would expect” to “We expected”

Done.

Line 94: change “to experience” to “would experience”

Done.

Line 109-113: You're assuming that the collection locations represent spawning locations, correct? I think it would be good to make that assumption clear to the reader, particularly because I don't think that it's a particularly good assumption to make. Catching fish during the spawning season, even if they're ripe, doesn't necessarily indicate that the fish are at or near spawning habitats. There is growing evidence (as of yet unpublished, to my knowledge) that the distribution of captured ripe C. artedi does not necessarily align with the distribution of deposited eggs. So, I would recommend clarifying and defending this assumption here. (I recognize that this would be a difficult issue to address with field sampling designs.)

For Lake Ontario, adults were collected on known spawning shoals in Chaumont Bay where the presence of embryos have been confirmed. We do not have direct observations of deposited eggs in Lake Superior, but previous literature suggests that spawning does occur in deep waters. To support this, we added additional text to clarify the assumption and citations to support (new Lines 115-120).

Line 157-159: Consider adding "to hatching" after "degree-days"

Done.

Line 167-168: I recommend changing this to "while" and making edits accordingly throughout the rest of the sentence. The "with" makes me think that these variables are included in the same model.

Done. Added “were analyzed” to the second clause to indicate that each continuous variable/trait was analyzed separately.

Line 173-176: I'm a bit confused here -- didn't you transform these to get them closer to normal? And "incubation period" includes DPF and ADD, correct? Why not just say something like "...and the remaining variables were analyzed..." or "...and the transformed variables were analyzed..."

Done. Changed to “and the transformed variables (i.e., DPF, ADD, LAH, and YSV) were analyzed”

Line 181: change “random-effects” to “random effects”

Done.

Line 239-240: Consider adding "for length-at-hatch" or similar here [at end of first clause]

Done.

Line 241-243: By this, do you mean that LAH differed by 3.2 and 0.2 % from low light to high light? I recommend rewording here to acknowledge that LAH was highest for the medium light treatment for Ontario, or perhaps removing this entirely given the lack of significant differences across light treatments.

We reworded the sentence to acknowledge the lack of difference in Lake Ontario (new Line 261-262).

Line 256-257: Perhaps be explicit here by adding "between populations."

Done.

Line 258-259: Maybe more appropriate to say something like "Lastly, LAH and YSV responded differently to varying light intensities between populations." or similar?

Done.

Line 274-276: “allow” - Consider changing to "have selected for" or similar, with edits accordingly hereafter.

Done.

Line 286-288: “and diverted energy away from somatic growth” - Perhaps remove this given the minimal change in LAH?

Done.

Line 293-296: I think this previous sentence is fine as is, but the word that came to mind when I read this section was "efficiency." Unless I'm misunderstanding the results, it appears as though yolk conversion to somatic tissue is less efficient at higher light treatments for LS cisco. Is that accurate? If so, maybe incorporate that wording here?

Done. Efficiency was incorporated in place of “rate”.

Line 296-299: Might be good to acknowledge the potential for adaptation somewhere in this sentence.

Done. Added “in the absence of adaptation” to acknowledge that selection could occur in the future.

Line 297: “may explain” - I recommend adding "in part" or similar here

Done.

Line 299: “between ^ Lakes” - insert “cisco populations from”

Done.

Line 355: add commas around “in some species”

Done.

Line 370-374: Maybe add a call for future work here, or something along those lines?

Added “Examining coregonine reproductive behavior and characterizing contemporary spawning habitat requirements is a logical and needed next step to build on our results.”

Line 378: add “-“ after “up”

Done.

Line 393: “limited” - maybe "complicated"?

Done.

Line 393: “ability” - Maybe "capacity" or "potential inability"? I think the latter is more what you're getting at here, and for some reason, "capacity" better communicates that in my opinion.

We agree the latter is more of the original thought but do not mind “capacity” either. Changed to “capacity.”

Reviewer #3: I was very impressed on the quality of the manuscript. Well done. Just a few technical changes and suggestions but overall well written.

Line 48: add “recruitment” after variable

Done.

Line 158” “degree-days” - Is this the same as temperature units?

Yes. Units (°C) were added.

Line 242: change “3.2” to “3.2%”

This sentence was modified based on a comment from Reviewer #2 and eliminates the need for this change.