First of all, I have to say that I'm not an expert in fish biology and ecology. I'm a theorist in the field of life history evolution.
The manuscript is based on a large data set covering the period 1984-2022. The results clearly show that the length-at-first-return of salmon from the sea to the studied river decreases with time. If this result has not yet been published, it is worth doing so. However, this result is not the main theme of the paper, which focuses on explaining the mechanism of this decrease in length. The statistical analysis is complex because several factors are studied with an even higher number of interactions. In addition, the coverage of such a long period is not uniform, which is understandable. To deal with this non-uniformity, the authors use bootstrapping on subsamples that are more uniform. I have no objections to this part of the paper. Unfortunately, only the most complex models, with all variables and all interactions considered, proved to be the best according to the Akaike criterion. This does not make further analysis easy. The paper seems to be overloaded with statistics in relation to results that are not entirely clear, partly because some variables are not independent. For example, the time spent in a river affects the size of the smolt, and the size of a smolt is functionally the initial size for growth at sea, and so must affect the growth curve at sea. Here the relationship is similar to a complex life cycle. It is not surprising that the interaction between sea age and river age is significant for reasons other than "effects of latent intrinsic differences between individuals depending on their life history". I suggest that the section "Statistical analysis" be omitted and that the appropriate parts be placed immediately before the presentation of subsections of relevant results. This will make the paper much easier to follow.
Lines 123-124. Different measures of length were used in different years. Fork length is presented in Figure 2 and presumably in the analysis. I could not find information on how total length was converted to fork length.
Lines 216-217. "Collinearity between variables was tested using Pearson correlation coefficients, and only variables with $|r| \leq 0.7$ were kept". There is nothing in the text about correlations between variables and the elimination of any variable. In fact, I would not be happy with such elimination and would expect an explanation of such high correlations instead. The matrix of correlations, perhaps in the supplementary information, might be helpful in understanding the causal system.
I am not sure whether it is worth showing Table 1. It would be sufficient to describe the two winners (models 19 and 21). On the other hand, it is striking that, with the exception of model 2, the average explained deviance is very similar, especially starting from model 5. Together with Figure 5, this suggests that only sea-age, river-age and their interaction are important, and such detailed analysis of other factors and their interactions could be placed in supplementary information to make the text more reader friendly.

Figure 4 is terrible. It looks like a jumble of lines, most of which are horizontal or almost horizontal. It would be better to explain everything in words.

There is no clear description of how the results of the analysis based on Table 1 were 'translated' into Figure 5, which is crucial for interpreting the results. Presumably such a description is present in lines 166-174, but it is completely abstract before the variables are defined. I would suggest a sentence or two before this figure is presented. The caption to this figure reads: "Mean estimated effects of each predictor modality...", but there is no indication of what this effect is (difference in length in cm, percentage change). Figures should be as self-explanatory as possible, because we usually look at figures before deciding whether to read a paper or not.

I suggest using path analysis to study the causal system. Of course, I'm not sure that such an analysis will give a clear picture, but why not try? The model could look like this

```
model<-'
length-at-first-return~sea-age+river-age+ctrAvgDOY+deltaDOY+year
sea-age~river-age+ctrAvgDOY+deltaDoy+year
river-age~year
'
fit <- cfa(model, data = ...)
semPaths(fit, ...)
```

My guess is that the effects of ctrAvgDOY and deltaDOY will be negligible, and so can be excluded from the plot in semPath by setting minimum to some small number; strong effects will be present from year to sea-age and from sea-age to length-at-first-return, and mild effects from river-age to length-at-first-return. Perhaps there will be some mild effects from year directly to length-at-first-return and to river age. If this analysis is successful, it could provide a more direct argument for the change in sea-age as the main driver of the decline in length-at-first-return, which is an important message of the paper.

The discussion is too long and contains some unnecessary elements. For example, the entire subsection "Strengths and limitations of long-term datasets" could be omitted. On the contrary, "An additional case study of decreasing average length of salmonids" could list other cases outside salmonids, after changing the title of the subsection.

The weakest point of the paper is its inadequate reference to life history theory. This is best illustrated by two sentences: (i) “The age-specific decrease in length-at-first return may have been due to length-specific selective pressure that targeted mainly larger individuals” and (ii) “Furthermore, most seal predation on salmonids seems to be opportunistic, with no 452 indication of length-dependent selection for larger fish”. Both statements invoke the false paradigm that mortality must be size selective to select for reduced (or increased) age at maturity and hence size at maturity. This paradigm is only correct in two cases: when population growth is unconstrained, or when density dependence acts by increasing mortality with density equally for all age classes. Clearly neither case is typical of fish. Here I must refer to my own work on the subject. I recommend starting with the introductory one Kozlowski (2006). Then there are three papers related to fish life history: the oldest Kozłowski and Uchmański (1987), the easiest to understand Kozlowski (1996) and the most difficult because of the mathematics, but also the most general Kozłowski and Teriokhin (1999). It follows from these papers that the increase in size- and age-independent mortality is a strong selective pressure for earlier maturation and smaller size. Thus, increased fishing pressure and increased seal predation may explain the pattern described in this paper.

Line 334. Contrasted variation? Do you mean “related variation”?

Lines 359-360. “Considering the very high within strategy length variation that can be observed in sea trout, it is likely to be a major factor here”. What is likely to be a major factor?

Lines 378-382. “We found that river age had a significant effect on length-at-first return, which indicates that the increase in length acquired in the river had long-term consequences until the first return to the river. This effect could have major implications for individuals’ future life history, such as the timing of maturation and duration of the sea sojourn, as length can strongly influence when smolt reach key thresholds that drive life history transition.” I don't understand the logic of the second sentence starting with "as length...".

Lines 383-387. Is it compensatory growth or lengthening of the sea phase of life?

Lines 502-505. Here papers on hyperallometry of reproduction should be cited (Barneche *et al.* 2018; Marshall & White 2019)

In summary, the paper can be published in a journal on fish biology and ecology after some relatively minor changes. To make it more interesting for a wide range of readers, it needs to be shortened and simplified by moving some material to supplementary information and, more importantly, it needs to be better related to life history theory.

Jan Kozłowski, 19th December 2023.

1. Barneche, D.R., Robertson, D.R., White, C.R. & Marshall, D.J. (2018). Fish reproductive-energy output increases disproportionately with body size. *Science*, 360, 642-645.
2. Kozlowski, J. (1996). Optimal allocation of resources explains interspecific life-history patterns in animals with indeterminate growth. *Proceedings of the Royal Society B*, 263, 559-566.
3. Kozlowski, J. (2006). Why life histories are diverse. *Polish Journal of Ecology*, 54, 585-605.
4. Kozłowski, J. & Teriokhin, A.T. (1999). Allocation of energy between growth and reproduction: The Pontryagin Maximum Principle solution for the case of age- and season-dependent mortality. *Evolutionary Ecology Research*, 1, 423-441.
5. Kozłowski, J. & Uchmański, J. (1987). Optimal individual growth and reproduction in perennial species with indeterminate growth. *Evolutionary Ecology*, 1, 214-230.
6. Marshall, D.J. & White, C.R. (2019). Have we outgrown the existing models of growth? *Trends in Ecology & Evolution*, 34, 102-111.