Review of : Assessing precocious maturation in salmon using ultrasound imaging

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The paper compares assessment of sexual maturation in Salmon parrs through visual and ultrasound examination. It concludes that ultrasound imaging of gonads provides a reliable assessment of sexual maturity, but requires skill and still presents a small percentage of error (<3%).

General remarks

The study objectives are clear. The text is short and to the point. The results are unambiguous regarding the quality of ultrasound imaging. So the study is already a success overall. Here are a few remarks, which, hopefully, should help the authors further improve it.

36–45 The first paragraph is very broad and somewhat vague. It would benefit from a few concrete examples (possibly taken from papers already cited) of the impact of global change on variables measured in long term monitoring programs, of the difficulty to parameterise models due to lack of data, etc. This would make the motivation for this particular study more apparent.

50 "frequency-dependent selection": do you consider this equivalent to "density-dependent selection" or is that something else? If non-trivial please explain. "mate competition": is that the competition *for mates* (e.g. among males for access to females) or the competition *between mates* (i.e. between male and female). Make it explicit.

54 Define "smoltify", for readers out of the field.

61–62 Is the 60% loss in stock estimated by Myers a general, average figure or an estimation based on only a few data points. If it is the former, this is major and should be emphasised more; if it is the latter, it should be specified.

125 How were the numbers of mature parrs detected by each method compared? Did you not compare the proportions rather than the numbers? Also, this sentence calls for a statistical test. Was one used (to compare the numbers/proportions)? If yes, specify which one.

130 How was the probability to miss a mature male tested. I suppose with a GLM as previously. Please specify it.

132 It is unlikely a R version from 2004 was used. Please update the citation (the R Core Team updates annually, see `citation()` for the up to date citation for R).

160–161 The interaction of `age * length` is not significant, which is actually good news for the interpretation of the effect of `length` by itself. And this pure factor effect is barely significant. So the discussion about the effect of length should be reviewed.

161 The main difference in the probability to produce milt seems to be the among-years variability. While this is an important finding, it also suggests that this strong variability is likely to hide the effect of other variables. It should be easier to partition that effect out, before investigating the effects of other variables, by using a mixed-effects model (and setting `year` and a random effect on either slope or, more likely and interestingly, intercept only).

165 Explain "uncertain": were those the parrs that looked mature but did not produce milt. Make this more explicit (and probably merge with the next sentence).

The operators, visually, missed 5.6% of the mature parrs; the ultrasound examination missed 2.7%. The difference between the two methods is not that large. So, in the conclusions, I would emphasise further the fact that the ultrasound approach is more objective while the visual inspection is more subjective and (possibly) requires more training. However, this small difference makes it questionable to determine which method should be taken as the reference to determine the "mistakes" of the other. You seem to have taken the ultrasound as reference to compute the mistakes of the operators but could that be imperfect? Can there be false positives?

Related to this, would you recommend to assess maturity through the production of milt (which is a objective and practical technique) and resort to ultrasound only for the ambiguous cases, or do you consider that ultrasound-only is a better approach in terms of accuracy and fish well being? I would like to see a bit more opinionated discussion about this in the conclusion.

Finally, in the conclusion, you write that the ultrasound imaging approach is "easily transferable". What do you mean exactly by that? Earlier, it was mentioned that the operation of the ultrasound scanner and the reading of the ultrasounds required a skilled and trained operator. Is this training easy to transfer (especially compared to the training to assess the fish visually, which seems to work pretty well too in the end)?

Language/formatting remarks

Many of these are *suggestions* for improved readability, written as imperative for shortness. Some are actual errors, but they should be easy to spot. The changes are marked as: ~~deletion~~ and **addition** or **change**.

Throughout the paper:

- please ensure a correct sequence and homogeneity of tenses. Methods are first described in the present tense, then switch to past; the same is true for results. Pick one tense and stick with it. Past tense is usually easier. I personally find present tense more engaging if you can make it work
- prefer passive forms to active ones, as usual in scientific papers. e.g. l. 96: "We assessed age through scale reading" -> "Age was assessed through scale reading".
- "gonads" should always be plural; there are two in each animal.
- p-values are usually noted with a lowercase, italic, "p" rather than a capital "P".

28 Reformulate as "By **allowing to see** the unseen"

37 "global changes": usually singular "global change". Change everywhere.

38 now, this is plural "monitoring program**s**" "major change**s**"

39 "Indeed" : no real causation here. "trigger" reads strange. Reformulate as "This global change makes it particularly important to be able to predict…"

43 "sex" -> "gender"

45 "individual**-level** data"

49 "would" -> "can"

50 "selection, ~~as~~ affected by **the** intensity"

51 "threshold **that triggers precocious maturation**"

52 "access to ~~mating with~~ large anadromous females **for mating**"

53 "but**,** as"

55 "frequency" -> "prevalence"?

55 "space**,** and": a comma before and is acceptable in enumerations of 3 or more elements and I find it makes them clearer. Also you used it on occasions so it needs to be consistent.

56 "1986) but precise" break the sentence "1986). Yet, precise"

57 "remain**s**" verbs at the third person of the present tense take an "s". Beware, this is a frequent mistake of yours.

58 "and **in the** management **of** Atlantic salmon **fisheries**"

58 Delete the double parenthesis after the citation

60 "survival **as well as** salmon" to avoid repeating a "and"

62 "parr**s**"

63 "of ~~adult~~ reproduction **by adults**"

64 "secretive" what do you mean by that? Is that the fact that they are mature "in secret" (i.e. not visible from their aspect), or that they "secrete" sperm hence are mature? I am not sure that "secretive" is necessary in either case but if you want to specify something, please make it more explicit.

64–66 "parrs **is due** to the complexity of ~~salmon~~**the** life cycle **of Atlantic salmon**. **But it** could also be ~~partly~~ due to the difficulty of quantifying the proportion of precocious**ly mature parrs** in wild salmon populations" alternative ending "the frequency of occurrence of precious maturation in wild salmon populations."

69 "extract milt **(sperm)**"

70 "look" -> "aspect"

72 "expert opinion**s** ~~data~~ in"

72–73 "due to **the potential for incorrect diagnosis and strong operator bias**."

75 "offer**s**"

76 "as **it** provides"

77–78 remove ", e.g." and add "in fish **for example**"

81 "non**-**mature" + "salmon**s**"

83 "offer**s**" + "out into the wild" -> "in the field"

84 "scanner**s**" + "enhance" -> "increase"

85 "salmonid~~s~~ population**s**"

86 "field**,** using"

87 "by testing" -> "and test"

87–88 "operator**-**related"

88 "factors ~~would~~ affect" + "assessment of **parr maturity**"

89 "we provide~~d~~" + "and **on** the interpretation"

93 "the **r**iver Oir"

94 "(parr**s**)"

95 "standard~~ized~~" + "protocol**. T**hey are **then** placed in a light an**a**esthetic **solution**,"

96 "scanned**,**" + "0.5 hour" -> "30 min" + delete "maximum" which is redundant with "within"

97 "2017**,**" + "examined **a total of** 850"

98 "using **a** traditional**,** phenotypic (**i.e.** external)**,** approach"

104 "of milt ~~(sperm)~~" was moved earlier, the first time the word "milt" was used.

105 "gonad**s** do~~es~~ not"

106 "look~~s~~ like"

108 "but ~~they~~ do not" + "rely" -> "relies"

109 "general**,** and subjective**,** appreciation"

114–116 "**T**he default setting**,** for muscular examination**,** **was selected**."

115 "transmit**s** ultrasounds, ~~we do not need to use~~ ultrasound transmission gel **was not needed**".

116 "freshwater~~,~~ and" a comma before "and" is not acceptable here, this is not an enumeration.

120 "when ~~the~~ gonad**s were** detected"

120–121 "when ~~the~~ gonad**s were too small to be** detected." and delete the rest of the sentence.

121 "Images" -> "Snapshots" or "Ultrasound snapshots"; change everywhere.

122 "exported **to** a USB" + "for post-**processing**."

125 "non-mature" -> "immature"; you use both forms, please homogenise (and "immature" seems most natural) + "one or the other" -> "each"

126–128 Merge into one sentence to make it immediately obvious what the "multivariate analysis" is: "A Generalized Linear Model (GLM) with a binomial distribution of errors was used to test which biological factors (among year, age, and body length) influenced the probability that a mature male was producing milt at the time of capture."

129 "mature ~~but~~ parr"

130 "identity**,** and time of ~~the~~ day"

131 "variability" -> "variance"

137–138 Reformulate as "immature individuals, the liver, stomach, caec~~as~~, and intestine could be identified." (also note that caeca is already plural, no s).

138 "on ~~the~~ live images"

139 "than on **the snapshots displayed here.**"

140 "diagnostic **of immature individuals**, as well"

141 "appear**s**" + "parr**s**"

141–143 "males), ~~as~~ gonads virtually fill the whole **abdominal** cavity **and** ultrasound images" + "(Figure 1b,c)**; d**igestive organs are hardly visible and ~~the shape of~~ the cavity is convex."

143 "doe~~s~~"

146 "provides **the same** objective **diagnosis** of maturation ~~status~~ in"

147 "and ~~the~~ ones that **did** (Figure 1c)."

148–149 "discriminate ~~between~~ truly mature parr**s**" + "can mistaken~~ly confuse~~ **for** mature male**s upon visual inspection**, because of"

152 "one**-year-**old"

153 "young**-of-the-**year"

154 "**r**iver Oir"

155–156 "not shown; **therefore the left flank is towards the bottom of the image and the right towards the top**.

156 "identified **by the letter "G".**"

159 "of ~~the~~mature male**s did** not produc**e** milt."

166 "looked ~~like~~ mature ~~parrs~~ were **indeed** mature."

168 "operator**s**"

170 "probability" -> "proportion" + Rephrase as "**This highlights how difficult it is to assess** parr maturation"

172 "None of the other variable**s** had a significant effect"; move this right after (p=0.008) on line 170

174–175 "**T**he sample size is too small to **assess the potential effect of external factors through multivariate analysis. Still, this shows that** ultrasound imaging"

176 "The **correct** interpretation"

177 "requires ~~a~~ good training ~~to improve the accuracy of the information~~. **In hindsight, w**e also"

178 "all **ultrasounds sh**ould"

Table 1: "Parr" -> "Parrs" + "looks" -> "looked"

185 "By **allowing to see** the unseen" + "offer**s**"

187 "characterize **the** true biological state **of individuals**"

188 "parr**s,** as"

194 "issue**s**."