Peer Community In Infections

Avian *Plasmodium* parasitaemia as an indicator of reproduction investment

Claire Loiseau based on peer reviews by **Luz García-Longoria** and 2 anonymous reviewers

Romain Pigeault, Camille-Sophie Cozzarolo, Jérôme Wassef, Jérémy Gremion, Marc Bastardot, Olivier Glaizot, Philippe Christe (2024) Spring reproductive success influences autumnal malarial load in a passerine bird. bioRxiv, ver. 3, peer-reviewed and recommended by Peer Community in Infections.
https://doi.org/10.1101/2023.07.28.550923

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Effects of the seasonal variations on within-host parasitaemia are still not well understood and potentially due to numerous factors, e.g. host and parasite species, host sex or age, or geographical regions. In this study, over three years in Switzerland, Pigeault et al. (2024) collected data on great tits reproductive outputs – laying date, clutch size, fledging success – to determine whether they were associated with avian *Plasmodium* parasitaemia before (winter), during (spring) and after (autumn) the breeding season. They focused on two lineages from two species: a highly generalist lineage *Plasmodium relictum* (lineage SGS1; Bensch et al. 2009) and a more specialized lineage *Plasmodium homonucleophilum* (lineage SW2). As previously found, they showed that parasitaemia level is low during the winter and then increase in spring (Applegate, 1970; Applegate 1971). Spring recurrences have been intensively studied but are still not well understood since many non-exclusive factors can provoke them, i.e environmental stressors, reproductive hormones, co-infections or bites of mosquitoes (Cornet et al. 2014).

Interestingly, the parasitaemia level during the winter before and during the breeding season were not associated to the reproductive success, meaning that birds in their populations with low parasitaemia during the winter had not more fledglings than the ones with a higher parasitaemia. However, the individuals who invested the most in the reproduction with a higher number of fledglings had also a higher parasitaemia in the following autumn. The number of laid eggs was not associated with the parasitaemia during the following autumn, showing that the initial investment in the reproduction is less important than the parental care (e.g. chicks feeding) in terms of mid/long term cost. The originality here is that authors followed populations during three periods of the year, which is not an easy task and rarely done in natural populations. Their results

highlight the mid/long-term effect of higher resource allocation into reproduction on individuals' immune system and ability to control parasite replication. Further analyses on various lineages and bird populations from other geographical regions (i.e. different latitudes) would be the next relevant step.

References:

Applegate JE (1971) Spring relapse of *Plasmodium relictum* infections in an experimental field population of English sparrows (Passer domesticus). Journal of Wildlife Diseases, 7, 37–42. https://doi.org/10.7589/0090-3558-7.1.37

Applegate JE, Beaudoin RL (1970) Mechanism of spring relapse in avian malaria: Effect of gonadotropin and corticosterone. Journal of Wildlife Diseases, 6, 443–447. https://doi.org/10.7589/0090-3558-6.4.443

Bensch S, Hellgren O, Pérez-Tris J (2009) MalAvi: a public database of malaria parasites and related haemosporidians in avian hosts based on mitochondrial cytochrome b lineages. Molecular Ecology Resources, 9, 1353-1358. https://doi.org/10.1111/j.1755-0998.2009.02692.x

Cornet S, Nicot A, Rivero A, Gandon S (2014) Evolution of plastic transmission strategies in avian malaria. PLoS Pathogens, 10, e1004308.https://doi.org/10.1371/journal.ppat.1004308

Pigeault R, Cozzarolo CS, Wassef J, Gremion J, Bastardot M, Glaizot O, Christe P (2024) Spring reproductive success influences autumnal malarial load in a passerine bird. bioRxiv ver 3. Peer reviewed and recommended by Peer Community In Infections. https://doi.org/10.1101/2023.07.28.550923

Reviews

Evaluation round #2

Reviewed by Luz García-Longoria, 12 January 2024

I consider that the authors have done a great job incorporating the small suggested changes. As far as I'm concerned, there are no further changes to be made; the work is correct, and the results will be very interesting for the rest of the scientific community.

Reviewed by anonymous reviewer 1, 04 January 2024

My comments and suggestions have been responded satisfactorily. I have no more comments.

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.1101/2023.07.28.550923
Version of the preprint: 2

Authors' reply, 20 November 2023

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Decision by Claire Loiseau, posted 08 October 2023, validated 09 October 2023

Revision

Dear authors, Pigeault et al.,

The three reviewers agreed that the manuscript is well-written and that the research design is correct. They all made minor comments that will certainly improve the interpretation of the results and the structure of the manuscript.

Please, read and reply to each of the comment.

Thank you very much and looking forward to reading the next version.

Reviewed by Luz García-Longoria, 13 September 2023

Firstly, I would like to congratulate the authors for the excellent field and laboratory work they have conducted. In this sense, the review that the authors did, showing the different results in relation to parasite load and reproductive success, is very interesting and well-structured. I like how the authors state the objective of the paper and present their hypothesis. The results are well-presented/structured. I find them very easy to follow. Secondly, I have some comments that hopefully will help improve the interpretation of the results and the structure of the manuscript.

Line 77: Maybe give some examples explaining this premise.

Line 79: I miss here (or after the next paragraph) a “however” clearly showing the knowledge gap that this study tries to cover.

Lines 80-109: I find this paragraph quite lengthy. Perhaps the authors could create a separate paragraph specifically focusing on avian malaria parasites and their characteristics, thereby splitting this paragraph into two. There is information related to malaria parasites, their attributes, and the controversies among various studies. It might be beneficial to organize these ideas into two distinct paragraphs.

Line 125: Could be possible to show the coordinates?

Line 131: I miss some information about how the authors collected breeding parameters, especially those related to fledging success or laying date. Do you monitored each nest boxes?

Lines 144-156: I wonder if authors check for double infections for Haemoproteus-Plasmodium and they did not find any Haemoproteus infection, or they just focused on Plasmodium. Anyway, this information should be indicated in this section, as I see it.

Line 158: “bird fitted as a random factor” Do you mean bird individual?

Line 166: I do not fully understand if authors only included those individuals captured more than once or all the individuals and correct this “issue” by including in the model bird individual as a random factor. Please, explain this in the Statistical analyses section.

Line 159: Some Plasmodium words are not in italics. Please, check.

Line 273: It is difficult to explain the positive/negative correlation between year seasons and parasitemia. However, authors could include some information about vector abundance or diversity in those areas. Of

course, parasitemia is not affected directly by vector abundance/diversity but could affect indirectly through prevalence. It is just an idea.

Line 292-294: Perhaps the authors could also include information about the potential role of these two lineages as specialist or generalist parasites. Although both lineages can infect a high number of host species (SW2=33 and SGS1=147, according to the MalAvi database), studying the infection dynamics in a specific population, such as great tits in Switzerland, should take into account the historical interaction between great tits and these two lineages. In my opinion, SW2 could adopt a more specialist strategy, while SGS1 might exhibit a more generalist one. Of course, it's important to note that this is a hypothesis that cannot be tested directly, but it could be mentioned as a possible explanation for the observed differences in parasite loads between these two malaria lineages in this population.

Reviewed by anonymous reviewer 2, 26 September 2023

The manuscript "Spring Reproductive Success Influences Autumnal Malarial Load in a Passerine Bird" is a very interesting work. Not only it was well-written, but the experiments were well-designed. I appreciated the opportunity to review it and I am looking forward to future manuscripts with a similar approach.

I have a few minor suggestions:

- To include parasite lineages in the abstract
- Some scientific names are not in italic (i.e., in the Statistical analysis section)
- I recommend formatting the lineage names and presenting them in capital letters: PARUS1 and TURDUS1. Additionally, I believe the authors could include the morphospecies linked to these lineages.

Reviewed by anonymous reviewer 1, 27 September 2023

Download the review