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Fire reduces parasite load in a Mediterranean lizard

Lola Álvarez-Ruiz, Josabel Belliure, Xavier Santos and Juli G. Pausas

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Review timeline

Original submission:	26 February 2021
1st revised submission:	31 May 2021
2nd revised submission:	21 June 2021
Final acceptance:	22 June 2021

Note: Reports are unedited and appear as submitted by the referee. The review history appears in chronological order.

Review History

RSPB-2021-0483.R0 (Original submission)

Review form: Reviewer 1

Recommendation
Major revision is needed (please make suggestions in comments)

Scientific importance: Is the manuscript an original and important contribution to its field?
Good

General interest: Is the paper of sufficient general interest?
Good

Quality of the paper: Is the overall quality of the paper suitable?
Acceptable

Is the length of the paper justified?
Yes

Should the paper be seen by a specialist statistical reviewer?
No

Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.
Yes

It is a condition of publication that authors make their supporting data, code and materials available - either as supplementary material or hosted in an external repository. Please rate, if applicable, the supporting data on the following criteria.

Is it accessible?
Yes

Is it clear?
Yes

Is it adequate?
Yes

Do you have any ethical concerns with this paper?
Yes

Comments to the Author
Comments on parasite, lizard and fire
This is an interesting study about the disruption of biotic interactions caused by fire. Some of the results are quite demonstrative of the reality of this disruption. However, I found many of the postulates of the studies quite fragile, and, as far as it is described, not verified. It follows that the conclusions, and hence the discussion, are questionable and not firmly established. They concern the life history of the species (dispersal and resistance to fire) some of the measured variables (erected scale), the analyses (no verification of the difference adult-juveniles, absence of a random factor, some results which are only slightly significant).
Detailed comments
Page 70-72: I do not understand this comment. I was thinking that the cleaning effect should be maximum for host species having some chance to survive to the fire (big home range or good capacity to run out of the fire and for parasite which restricted home range
Pages 74-78: I would have predicted the reverse: low survival for species with small home range etc. Can you elaborate more on how they survive??
Lines 94-98: this is not because you have a small home range tht you have not good dispersal ability!!! You have to demonstrate that dispersal rate ARE small as well
Lines 129-134: have you really experimentally measured this relationship
Lines 166-168: why remove the random factor? Has you selected the burn-unburn pairwise comparison randomly, you should have some random factors somewhere? No?
Lines 186-188: did you test for juveniles again adults? In some other species, the number of such parasites is influences strongly by age.

Review form: Reviewer 2

Recommendation
Accept with minor revision (please list in comments)

Scientific importance: Is the manuscript an original and important contribution to its field?
Excellent

General interest: Is the paper of sufficient general interest?
Excellent

Quality of the paper: Is the overall quality of the paper suitable?
Excellent

Is the length of the paper justified?
Yes

Should the paper be seen by a specialist statistical reviewer?
No

Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.
No

It is a condition of publication that authors make their supporting data, code and materials available - either as supplementary material or hosted in an external repository. Please rate, if applicable, the supporting data on the following criteria.

Is it accessible?
Yes

Is it clear?
Yes

Is it adequate?
Yes

Do you have any ethical concerns with this paper?
No

Comments to the Author
Proceedings of The Royal Society B
RSPB-2021-0483
Fire reduces parasite load in a Mediterranean lizard
General Overview: This paper is nicely written and will be a nice contribution to the literature. The readers of the journal will be highly interested in these results and I commend the authors for merging conservation biology, fire ecology, and parasitology in this study. I have a few minor comments to consider and then I recommend publication.
Line 28: Consider inserting 'would' before 'have'
Line 38: The word 'consequences' has a negative connotation that seems inappropriate here. Perhaps the words 'benefits' or 'effects' more accurately articulate the intent of this sentence.
Line 48: The word 'good' is subjective. Perhaps 'robust' is less subjective and implies that the breadth and depth of knowledge is substantial. Or perhaps say that… "The knowledge of the role of fire in the ecology and evolution of plants is robust with extensive breadth and depth"…
Line 55: This is awkward. Consider rewording "being the immunological the most intricate one" as I am not sure what you mean here.
Line 61: Add 'in independent terrestrial stages perhaps'?
Line 65: Fire has also been implicated for reducing fly parasites of livestock also which is supportive of the agricultural context. See the following citations: Scasta, J. D., Engle, D. M., Talley, J. L., Weir, J. R., Stansberry, J. C., Fuhlendorf, S. D., & Harr, R. N. (2012). Pyric-herbivory to manage horn flies (Diptera: Muscidae) on cattle. Southwestern Entomologist, 37(3), 325-334. The results suggest that it combusts overwintering resources for terrestrial stages and alters animal distribution.
Line 67: Awkward wording again here… Perhaps change to "… thus, fire reduces vector-borne diseases pathogen transmission by direct and indirect effects on vectors" or something to that effect.
Line 135: cleaning effect of fire is sometimes in quotation marks (see Line 142). Need to be consistent. Perhaps just put quotation marks the first time in the manuscript.
Line 140: Seems to be missing the closing parenthesis after (ca. 3 years; [29]

Line 192-193: The probability of infection increasing with lizard size is very interesting and I wonder if it is a function of age? In sheep, there is a very cryptic parasite (keds; Melophagus ovinus) that live their entire life embedded in the wool. Scientists have discovered that older sheep have greater infestations of keds and I wonder if that is what is going on here.
Scasta, J. D., & Koepke, K. (2016). Host-parasite ecology of keds (Melophagus ovinus (L.)) relative to sheep breed and age on Wyoming rangeland. Livestock Science, 189, 17-22.
Line 238: 'There are evidences…' is awkard to me. Perhaps 'Evidence suggests that…'
Line 241: I don't think this is first example of this and suggest you delete this sentence. You have referenced a number of papers that show similar results just with different taxa (i.e., the work by Hossack [63] showing reduced chytrid infection in an amphibian as example). Perhaps this is the first time with this taxa or in this system, for which, you could also contextualize this statement.

Decision letter (RSPB-2021-0483.R0)

06-Apr-2021

Dear Dr Álvarez-Ruiz:

I am writing to inform you that your manuscript RSPB-2021-0483 entitled "Fire reduces parasite load in a Mediterranean lizard" has, in its current form, been rejected for publication in Proceedings B.

This action has been taken on the advice of referees, who have recommended that substantial revisions are necessary. With this in mind we would be happy to consider a resubmission, provided the comments of the referees are fully addressed. However please note that this is not a provisional acceptance.

The resubmission will be treated as a new manuscript. However, we will approach the same reviewers if they are available and it is deemed appropriate to do so by the Editor. Please note that resubmissions must be submitted within six months of the date of this email. In exceptional circumstances, extensions may be possible if agreed with the Editorial Office. Manuscripts submitted after this date will be automatically rejected.

Please find below the comments made by the referees, not including confidential reports to the Editor, which I hope you will find useful. If you do choose to resubmit your manuscript, please upload the following:

1) A 'response to referees' document including details of how you have responded to the comments, and the adjustments you have made.
2) A clean copy of the manuscript and one with 'tracked changes' indicating your 'response to referees' comments document.
3) Line numbers in your main document.
4) Data - please see our policies on data sharing to ensure that you are complying (https://royalsociety.org/journals/authors/author-guidelines/#data).

To upload a resubmitted manuscript, log into http://mc.manuscriptcentral.com/prsb and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Resubmission." Please be sure to indicate in your cover letter that it is a resubmission, and supply the previous reference number.

Sincerely,
Dr Sasha Dall
mailto: proceedingsb@royalsociety.org

Associate Editor
Board Member: 1
Comments to Author:
This study deals with an ignored aspect of forest fires, and as such of interest for the audience of the Proceedings. Both reviewers however raise a number of points, mainly related to methodological issues, but also about hidden assumptions, that need to be addressed before we can consider accepting the contribution.

Reviewer(s)' Comments to Author:

Referee: 1
Comments to the Author(s)
Comments on parasite, lizard and fire
This is an interesting study about the disruption of biotic interactions caused by fire. Some of the results are quite demonstrative of the reality of this disruption. However, I found many of the postulates of the studies quite fragile, and, as far as it is described, not verified. It follows that the conclusions, and hence the discussion, are questionable and not firmly established. They concern the life history of the species (dispersal and resistance to fire) some of the measured variables (erected scale), the analyses (no verification of the difference adult-juveniles, absence of a random factor, some results which are only slightly significant).
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Referee: 2
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Scasta, J. D., & Koepke, K. (2016). Host-parasite ecology of keds (Melophagus ovinus (L.)) relative to sheep breed and age on Wyoming rangeland. Livestock Science, 189, 17-22.
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Author's Response to Decision Letter for (RSPB-2021-0483.R0)

See Appendix A.

RSPB-2021-1230.R0

Review form: Reviewer 2

Recommendation
Accept as is

Scientific importance: Is the manuscript an original and important contribution to its field?
Excellent

General interest: Is the paper of sufficient general interest?
Excellent

Quality of the paper: Is the overall quality of the paper suitable?
Excellent

Is the length of the paper justified?
Yes

Should the paper be seen by a specialist statistical reviewer?
No

Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.
No

It is a condition of publication that authors make their supporting data, code and materials available - either as supplementary material or hosted in an external repository. Please rate, if applicable, the supporting data on the following criteria.

Is it accessible?
No

Is it clear?
N/A

Is it adequate?
N/A

Do you have any ethical concerns with this paper?
No

Comments to the Author
Thank you for your attention to the criticisms in the review process. I believe this is an important contribution to the scientific literature.

Decision letter (RSPB-2021-1230.R0)

21-Jun-2021

Dear Dr Álvarez-Ruiz

I am pleased to inform you that your Review manuscript RSPB-2021-1230 entitled "Fire reduces parasite load in a Mediterranean lizard" has been accepted for publication in Proceedings B.

The referee(s) do not recommend any further changes. Therefore, please proof-read your manuscript carefully and upload your final files for publication. Because the schedule for publication is very tight, it is a condition of publication that you submit the revised version of your manuscript within 7 days. If you do not think you will be able to meet this date please let me know immediately.

To upload your manuscript, log into http://mc.manuscriptcentral.com/prsb and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision.

You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, upload a new version through your Author Centre.

Before uploading your revised files please make sure that you have:

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2) A separate electronic file of each figure (tiff, EPS or print-quality PDF preferred). The format should be produced directly from original creation package, or original software format. Please note that PowerPoint files are not accepted.

3) Electronic supplementary material: this should be contained in a separate file from the main text and the file name should contain the author's name and journal name, e.g authorname_procb_ESM_figures.pdf
All supplementary materials accompanying an accepted article will be treated as in their final form. They will be published alongside the paper on the journal website and posted on the online figshare repository. Files on figshare will be made available approximately one week before the accompanying article so that the supplementary material can be attributed a unique DOI. Please see: https://royalsociety.org/journals/authors/author-guidelines/

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If you wish to submit your data to Dryad (http://datadryad.org/) and have not already done so you can submit your data via this link
http://datadryad.org/submit?journalID=RSPB&manu=RSPB-2021-1230 which will take you to your unique entry in the Dryad repository.

If you have already submitted your data to dryad you can make any necessary revisions to your dataset by following the above link.

5) For more information on our Licence to Publish, Open Access, Cover images and Media summaries, please visit https://royalsociety.org/journals/authors/author-guidelines/.

Once again, thank you for submitting your manuscript to Proceedings B and I look forward to receiving your final version. If you have any questions at all, please do not hesitate to get in touch.

Sincerely,
Dr Sasha Dall
mailto:proceedingsb@royalsociety.org

Associate Editor
Comments to Author:
I think the authors have passed all the hurdles! I think no further work is necessary.

Reviewer(s)' Comments to Author:

Referee: 2
Comments to the Author(s).
Thank you for your attention to the criticisms in the review process. I believe this is an important contribution to the scientific literature.

Decision letter (RSPB-2021-1230.R1)

22-Jun-2021

Dear Dr Álvarez-Ruiz

I am pleased to inform you that your manuscript entitled "Fire reduces parasite load in a Mediterranean lizard" has been accepted for publication in Proceedings B.

You can expect to receive a proof of your article from our Production office in due course, please check your spam filter if you do not receive it. PLEASE NOTE: you will be given the exact page length of your paper which may be different from the estimation from Editorial and you may be asked to reduce your paper if it goes over the 10 page limit.

If you are likely to be away from e-mail contact please let us know. Due to rapid publication and an extremely tight schedule, if comments are not received, we may publish the paper as it stands.

If you have any queries regarding the production of your final article or the publication date please contact procb_proofs@royalsociety.org

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All supplementary materials accompanying an accepted article will be treated as in their final form. They will be published alongside the paper on the journal website and posted on the online figshare repository. Files on figshare will be made available approximately one week before the accompanying article so that the supplementary material can be attributed a unique DOI.

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Thank you for your fine contribution. On behalf of the Editors of the Proceedings B, we look forward to your continued contributions to the Journal.

Sincerely,
Editor, Proceedings B
mailto: proceedingsb@royalsociety.org

Appendix A

Response to referees

Reviewer(s)' Comments to Author:

Referee: 1

Comments on parasite, lizard and fire

This is an interesting study about the disruption of biotic interactions caused by fire. Some of the results are quite demonstrative of the reality of this disruption. However, I found many of the postulates of the studies quite fragile, and, as far as it is described, not verified. It follows that the conclusions, and hence the discussion, are questionable and not firmly established. They concern the life history of the species (dispersal and resistance to fire) some of the measured variables (erected scale), the analyses (no verification of the difference adult-juveniles, absence of a random factor, some results which are only slightly significant).

RE: Thank you for your useful comments. We have followed all detailed comments below for improving the quality of the manuscript.

Detailed comments:

Page 70-72: I do not understand this comment. I was thinking that the cleaning effect should be maximum for host species having some chance to survive to the fire (big home range or good capacity to run out of the fire and for parasite which restricted home range

RE: Rephrased for clarification (Introduction, 4th paragraph). Note that species with large home range or highly mobile move to outside of the burned area where they can get infected by parasites in the unburned. So the cleaning effect by fire should only be significant in species with low mobility and small home range that survived the fire and remain inside the burned. Specifically we modified the text as follows: “Fire may provide a significant parasite ‘cleaning effect’ from which hosts could benefit. This effect should be

especially relevant for host species with the ability to survive fires and remain postfire living in burned areas. That is the case of species with traits and strategies that confer them some fire survival [5,27] and that show limited mobility and small home ranges; hosts with large home ranges may alternate between burned and unburned patches and thus the potential cleaning effect by fire may be blurred."

Pages 74-78: I would have predicted the reverse: low survival for species with small home range etc. Can you elaborate more on how they survive??

RE: Yes, we addressed the survival matter in the previous comment and we added the following sentence on lizard survival in the Introduction (4th paragraph): "We selected a lizard as model system because many lizard species survive wildfires by seeking refuge in burrows, crevices, under rocks, or among roots within the burn (e.g: burrowing lizards [29–31]), and they often spend their entire lives within a burned area due to their small home ranges [32], low vagility and dispersal rates [33]."

Lines 94-98: this is not because you have a small home range tht you have not good dispersal ability!!! You have to demonstrate that dispersal rate ARE small as well

RE: The habitat used by lizards is determined mainly by the home range but it is true that dispersal movements could happen in between burned/unburned areas. *P. algirus* is a territorial lizard and dispersion behavior occurs in juveniles seeking establishment in a new territory. It is demonstrated that dispersal distances of *P.algirus* are very low. In a two-year study in hatchlings of this species, the short distances between captures and recaptures were very low (11.5 +- 1.50 m, Civantos et al. 1999). Moreover, to search for emigrating individuals they surveyed a band of 20 m and 90 m from the border of the study plot. They only found 2 individuals in the 20-m zone surrounding the study plot and they did not recapture any individuals in the contiguous 110 m wide area adjacent to the study plot. We have now included a sentence stating that the limited dispersal abilities of *P. algirus* make

it unlikely that sampled lizards inhabited both burned/unburned areas (see 'Study system', 1st paragraph).

Lines 129-134: have you really experimentally measured this relationship

RE: We have personal observations (e.g., Fig. S5) and there are similar observations in the bibliography (e.g., Hare et al. 2002 [ref 52]) supporting it. We have now added them to the manuscript and rephrased the paragraph to make it clearer in this point (section 'Lizard sampling and parasite quantification', 3rd paragraph). Note that in this study we first present data from 3 populations (recent wildfires) in which we exhaustively examine host's parasite load and it shows a drastic fire-driven parasite reduction. Them we present data from other 5 populations in which we counted a parasitism indicator and the results are supportive and coherent with the first approach. The use of these two approaches (two methods) strength our conclusions.

Lines 191: why remove the random factor? Has you selected the burn-unburn pairwise comparison randomly, you should have some random factors somewhere? No?

RE: there is a tendency to consider that the minimum number of levels of a factor to be considered random is 5 (Gelman and Hill, 2006), however, it is true that this is more relevant for random slopes than for random intercepts, which is our case. For this reason, have now included the same analysis but including Location as a random factor, as suggested (Table 1a). Note that the results are the same.

Gelman, A., & Hill, J. (2006). Data analysis using regression and multilevel/hierarchical models. Cambridge university press.

Lines 186-188: did you test for juveniles again adults? In some other species, the number of such parasites is influences strongly by age.

RE: We included a sentence in Methods section to clarify this point.
We also moved this part on lizards sampling to earlier in the text, before mite quantification section. In line 164 we replaced " and adults were sexed" with "Sex determination was carried out by observing femoral pores that are more conspicuous in adult males (Iraeta et al. 2011), therefore the sex of juvenile individuals could not be determined.

To test the effect of sex on parasitism, we first analyzed only adult lizards. We did not find any significant effect of sex and thus, we included juveniles (undetermined sex) in the analysis. In this second analysis merging adults and juveniles we include the size. Indeed, lizard's size has a significant effect on parasitism (Table 1) but the interaction with fire condition was not significant. Which means that bigger lizards can carry more parasites but the fire-driven reduction of parasites is not related to this fact.

Referee: 2

Comments to the Author(s)

General Overview: This paper is nicely written and will be a nice contribution to the literature. The readers of the journal will be highly interested in these results and I commend the authors for merging conservation biology, fire ecology, and parasitology in this study. I have a few minor comments to consider and then I recommend publication.

Line 28: Consider inserting 'would' before 'have'
RE: Inserted.

Line 38: The word ‘consequences’ has a negative connotation that seems inappropriate here. Perhaps the words ‘benefits’ or ‘effects’ more accurately articulate the intent of this sentence.

RE: Replaced ‘consequences’ with ‘effects’.

Line 48: The word ‘good’ is subjective. Perhaps ‘robust’ is less subjective and implies that the breadth and depth of knowledge is substantial. Or perhaps say that… “The knowledge of the role of fire in the ecology and evolution of plants is robust with extensive breadth and depth”…

RE: Done. We replaced the sentence “There is relatively good knowledge on the role of fire in the ecology and evolution of plants”, with “ The knowledge of the role of fire in the ecology and evolution of plants is robust, with extensive breadth and depth”

Line 55: This is awkward. Consider rewording “being the immunological the most intricate one” as I am not sure what you mean here.

RE: To increase clarity we have rephrased “being the immunological the most intricate one” for “among which the immunological response is probably the most complex [10,11]” in line 56.

Line 61: Add ‘in independent terrestrial stages perhaps’?

RE: Yes, we have added “the independent terrestrial stages” in line 62.

Line 65: Fire has also been implicated for reducing fly parasites of livestock also which is supportive of the agricultural context. See the following citations: Scasta, J. D., Engle, D. M., Talley, J. L., Weir, J. R., Stansberry, J. C., Fuhlendorf, S. D., & Harr, R. N. (2012). Pyric-herbivory to manage horn flies (Diptera: Muscidae) on cattle. Southwestern Entomologist, 37(3), 325-334.
The results suggest that it combusts overwintering resources for terrestrial stages and alters animal distribution.

RE: We have now included this study in the context of agricultural use of fire.

Line 68: Awkward wording again here… Perhaps change to "… thus, fire reduces vector-borne diseases pathogen transmission by direct and indirect effects on vectors" or something to that effect.

RE: We have rephrased it for clarification. Line 69: We replaced "…thus, fire contributes reducing vector-borne diseases" with "…thus, fire reduces the transmission of vector-borne diseases by direct and indirect effects on vectors"

Line 135: cleaning effect of fire is sometimes in quotation marks (see Line 142). Need to be consistent. Perhaps just put quotation marks the first time in the manuscript.

RE: We have now put quotation marks only the first time that 'cleaning effect' is mentioned (in the abstract and introduction, line 64).

Line 140: Seems to be missing the closing parenthesis after (ca. 3 years; [29]

RE: Fixed.

Line 192-193: The probability of infection increasing with lizard size is very interesting and I wonder if it is a function of age? In sheep, there is a very cryptic parasite (keds; Melophagus ovinus) that live their entire life embedded in the wool. Scientists have discovered that older sheep have greater infestations of keds and I wonder if that is what is going on here.
Scasta, J. D., & Koepke, K. (2016). Host-parasite ecology of keds (Melophagus ovinus (L.)) relative to sheep breed and age on Wyoming rangeland. Livestock Science, 189, 17-22.

RE: Yes, lizards' age can determine parasite load in the sense that older individuals have greater probabilities of suffering reinfection episodes and thus, they would show more parasite tracks (raised ventral scales). Also, bigger animals will be able to carry more parasites. Since age class correlates with body size, we believe that it is more appropriate to analyze the continuous variable SVL instead of the categorical variable age.

We included a sentence addressing this matter in Line 320 "Parasitism increased with lizards' size (probability of carrying parasites, Table 1a; and parasite tracks, Table 1b). This is because size correlates with age so older individuals have more chances of getting infected, but also they can accumulate more tracks of past parasitic infections [62]" and a reference of this size/age effect in lizards.

Line 238: 'There are evidences…' is awkward to me. Perhaps 'Evidence suggests that…'

RE: Replaced

Line 241: I don't think this is first example of this and suggest you delete this sentence. You have referenced a number of papers that show similar results just with different taxa (i.e., the work by Hossack [63] showing reduced chytrid infection in an amphibian as

example). Perhaps this is the first time with this taxa or in this system, for which, you could also contextualize this statement.

RE: There are some studies on the effect of fire on host diseases provoked by a virus (increasing prevalence of hantavirus, Ecke) and fungi (decreasing prevalence of chytridiomycosis, Hossak); however, there are no other studies on parasites. In any case it is true that the distinction between disease and parasite may be controversial so we have make it clearer that we talk about ectoparasites and wild populations (line 333).