*Dear Gabriel Ramos-Fernández,*

*Thank you very much for considering our manuscript and for allowing us to revise it. We have edited the text following the helpful suggestions of the reviewers. Most of the changes were related to the structure of the discussion but we also have added some details on the methods. In addition, we have included one more co-author to recognize her contribution in terms of data provision, which was not previously recognized.*

*Please, find the replies to the reviewers in italics below each comment in the attached document. We have uploaded the revised manuscript on biorXive and, for your use, we also upload here the new version with track changes (line number indicated in the replies refers to the manuscript with track changes).*

*As in the previous version, data and scripts for revision use can be found here [https://datadryad.org/stash/share/ribkWEC_BGfiJL5dYxSZq5Yq5Ju7hWmNKEtAPZFjySQ](https://datadryad.org/stash/share/ribkWEC_BGfiJL5dYxSZq5Yq5Ju7hWmNKEtAPZFjySQ) and will be publicly available at the end of the review process.*

*We hope that the new version may be considered worthy of recommendation on PCI Network Science and, waiting to hear back from you, we send you our best regards.*

*Alice Brambilla on behalf of the authors*


## Reviews

### Reviewed by Brenda McCowan, 31 Jan 2022 22:24

Review of "Long term analysis of social structure: evidence of age-based consistent social preferences in Alpine ibex" by Brambilla et al.
This manuscript presents a very nice longitudinal study on the social structure of adult male Alpine ibex. The data structure collected allowed the authors more of a "mile-high" view of this social structure over a 10-year period, as opposed to a detail understanding of the mechanisms contributing to the social network patterns observed across time. Given this constraint, the authors have made the most of these data rarely focused on males in a species that is relatively unknown and thus have contributed something novel to the network literature. The network approaches and supporting statistics seem appropriate, the individual-level variables matched examining attributes of males found in previous studies, and the scope of the longitudinal data impressive.

*Reply: Dear Brenda McCowan, thank you very much for the revision of our manuscript and for your helpful comments. We have edited the text as suggested, particularly the discussion section which has been restructured following the same structure of the methods and results sections (see below for details). You can find the replies in italics below each of your comments (line number refers to the manuscript with track changes).*

Other than a few minor questions under specific sections below, I think the bulk of revision should focus on the Discussion. It currently reads quite repetitive and a bit jumbled. So, I suggest that the authors reorganize the discussion into sections addressing each of their points as listed in their conclusionary remarks (lines 704-715), reflecting the ways in which the authors set up the Methods and Results. The authors also should be careful to indicate explicitly when they are being especially

speculative in the discussion (e.g., individual differences as Res and personality, months preceding death interpretation).

Discussion
• Association Dynamics of Networks
o Network Cohesion
o Predictors of Association
o Importance of individual differences (recognizing that only a random effect was used to explore this)
• Seasonal and Annual Changes to Networks
o Ecological constraints
o Social needs
o Demographic influences

*Reply: Thank you for the suggestion. To avoid repetition, we have removed part of the first paragraph of the discussion (which was only a recap of the main findings that were however repeated and discussed more in detail later). As you suggested, we have also re-structured the text following the outline of methods and results, in order to ease following the thread of the discussion. Finally, we have further made explicit when our interpretations were speculative (e.g., individual differences (lines 677-679), causes of death (line 663)).*

Specific comments
• Change title to "Review of "Long term analysis of social structure: evidence of age-based consistent social preferences in male Alpine ibex".

*Reply: As suggested, we have changed the title to "Long term analysis of social structure: evidence of age-based consistent social preferences in male Alpine ibex".*

• Lines 329-333: Is there any concern that the removal of a large number of individuals for the longitudinal analysis might fail to represent the network in a given year?

*Reply: The QAP used to test the consistency of the relationship between years, compared the association values (HWI) calculated for each dyad in each year. Those pairwise values were not affected by the removal of other individuals from the network as they were calculated based on the number of times the two individuals were observed together and separately. For this reason, there is no concern that the subsetting of the network may lead to biased results concerning the dyadic values of association. As our intention was to quantify the stability of relationships, not to explore the stability of the network structure as a whole, subsetting to only include individuals consistently present was justifiable.*

• Line 433: Did the authors test whether there was a nonlinear relationship with dominance and age like they did for strength centrality?
• Lines 452-454: See comment for Line 433.

*Reply: The procedure and the aims of the analysis used to produce the results originally presented at lines 452-454 (which aimed at investigating factors affecting node measures and were done using GLMMs) were different from that of line 433, where we used QAP to analyse the relationship between dominance and age difference matrices. Due to the nature of the data (i.e., matrices of age difference) and of the QAP test, only linear relationship between dominance and the age difference was tested.*

• Lines 456-458: Any thoughts as to why such a strong random effect of individual? Any data on individual attribute other than age and dominance?

*Reply: We had further individual attribute as, for example, body mass and rank (i.e., Elo-score, which we expect may be also related to personality), but they were all correlated with age, so it was not possible to add them in the same model nor to disentangle the contribution of each of them. Ideally, analysis should be done on individuals of the same age class to test for the effect of the other individual attributes, and thus better understand the effect of individual identity/personality, but we had not enough power to conduct a meaningful analysis as the number of individuals of the same age was limited. As we could not explore the issue more in depth, to avoid conveying excessive importance on this finding, we have added extra caution in the interpretation of this result (lines 677-679).*

• Lines 510-512, 524-526: are the data not in as form where the authors might run a community analysis (recognizing that the densities are close to 1). Could they threshold the data to augment the dyadic analyses indicating these stable associations are occurring in small groups and merge and split? I don't really see an analysis specifically supporting that observation (or mechanism resulting in the overall pattern observed directly here).

*Reply: Thank you for this comment. We have removed this observation (that there might be small groups with stable composition that merge and split) from the text as we agree we have not run a community analysis to specifically support this conclusion.*


**Reviewed by Sandra Smith Aguilar, 16 Jan 2022 02:34**

The paper is aimed at investigating the temporal dynamics of the social network of male alpine ibex using ten years of association data. They specifically looked at the consistency of male associations through time, the relationship between individual attributes and network metrics, the change in the social network structure associated to different ecological factors and the relationship between structural characteristics and demographic factors.

The study is presented in a clear and clean manuscript, making it easy and enjoyable to read. Authors clearly paid careful attention to structure. The introduction presents appropriate background information to understand the problem, clearly stating objectives and predictions with a corresponding methods section which allows the reader to understand how the objectives were addressed. The results were presented in a way which corresponded to the methods, highlighting those which were relevant for the study question with appropriate tables and figures to accompany the text. Then, the relevant findings were integrated into an appropriate discussion which drew from knowledge on the study species and others, to highlight the contributions of the study for the understanding of Alpine ibex sociality. Overall I think it is a very good study which not only contributes with aspects of Alpine ibex sociality, but also has merit for its methodological approach.

*Reply: Dear Sandra Smith Aguilar, thank you very much for your helpful comments. We have edited the text as suggested and added some details or clarification when needed, particularly in the discussion and method sections. You can find the replies in italics below each of your comments (line number refers to the manuscript with track changes). Please, also note that the discussion has been further edited following the comments of the other reviewer.*

I just have some very minor comments and suggestions for the authors:

L94. Suggested edit: "…As recent studies on personality (…) have shown…"

*Reply: Edited*

L128-129. Please check and correct the sentence

*Reply: Sentence edited as follows (lines 128-129): "To fill those gaps, we performed a long-term analysis of male social structure in a gregarious ungulate: the Alpine ibex (Capra ibex)"*

L193. Edit "migration" to "migrations"

*Reply: Edited*

L217-219. And did you record any

*Reply: Sorry, we did not understand this comment*

L224-227. So you defined an association if two individuals were seen in the same group during one day, independently of how many times they were observed per day?

*Reply: The data collection for the group composition was done, as described, twice a day when possible (early morning and late afternoon) or only once a day (either in the morning or in the afternoon). Each survey was considered as independent regardless from the day when it was conducted. Given the strongly bimodal activity pattern observed during summer, observation of animals at dawn of a given day can be considered as independent from the observation of animals at dusk of the same day in the same way as observations conducted at dusk can be considered independent from those conducted at dawn the following day. During the rest of the day, other observations were done (e.g., focal observations) but, to avoid sampling bias, we did not record these associations for our study.*
*To better clarify how we collected the data, we have edited the sentence as follows (lines 224-228): "Association data were collected during daily surveys conducted when the animals were active/feeding. When possible, associations were collected twice per day, after dawn and before dusk, considering each survey as independent due to the strongly bimodal daily activity pattern typical of the species, ....".*

L459. Edit "determinations" to "determination" and correct in other instances further on.

*Reply: Edited*

L521-522. It would be interesting to expand on this. Why wouldn't we expect individual differences in centrality given the other results? Or does it mean that certain individuals, have particularly high/low centralities regardless of their age? What other attributes could be relevant in this respect? Personality?

*Reply: In the initial submission, the first part of the discussion was just a recap of the results, without much interpretation. We then went through all the results expanding and discussing them. The result initially presented at lines 521-522 was interpreted as a fact that individuals may have high/low centralities measures regardless of their age and a possible explanation (given later in the text, lines 657-670 of the original submission) was indeed the presence of individual differences/personality. However, we didn't have enough data to properly test the presence of personality and we have clarified it in the discussion. Moreover, in the edited version of the*

*manuscript, we have restructured the discussion to avoid repetitions so the lines you referred to were removed. You will see in lines 667-681 the full discussion of this result.*

L534. Edit "connection" to "connections"

*Reply: Edited*

L541. Edit: "snow energetically demanding" to "snow is energetically demanding"

*Reply: Edited*

L546: Maybe change "competitions" for "contests"?

*Reply: Edited*

L577-578. If resources were distributed more heterogeneously, wouldn't we expect lower home range overlap due to individuals spreading around to different food patches?

*Reply: In the work from Peigner et al. (2019), when resources were distributed heterogeneously (i.e., most of the resources concentrated in the same place), home ranges had higher overlap as all the animals were concentrated where the resources were available. Instead, during summer, when resources were more spread, animals were free to roam more and thus home ranges overlap was lower.*

L622-623. Do you think you would find anything interesting if looking at the relationship between the average rank of associates and changes in rank from one season to the next?

*Reply: This analysis was conducted on the matrices of associations / rank differences implying dyadic relationships. If we correctly understood your comment, this framework would not allow to test what you suggest. However, further studies focusing on yearly (or even life-time) individual changes in ranks would be very interesting. We are indeed working on them for another project, and we will consider to adding as covariates also the position in the network.*

L684. Could you provide us with an approximate home range size?

*Reply: The approximate home range size of Alpine ibex in the study area is 450-500 ha. We have added this information in the text (lines 533 and 715).*

L695-697. In this regard, what do you think was the effect of using a seasonal scale to build the networks? Do you think it would be worth looking at a finer temporal scale in future studies to explore details of the social dynamics?

*Reply: Thank you for the comment, this is a very good point and we have added it to the discussion (lines 731-735). Particularly regarding the effect of demographic changes on the network structure, however, I'm not sure that using a finer scale would change the results. Most of the deaths occur during winter so the demographic structure of the population is rather stable during spring-summer. Nevertheless, using a finer scale (e.g., build daily networks) coupled with more detailed data collection on associations (e.g., using the nearest neighbour method or conducting focal observations), could help in better understanding the factors shaping associations or also the network structure and we have added this to the discussion (lines 731-735).*

L708. Change "association" for "associations"

*Reply: Edited*