Peer Community In Ecology

Consistent individual differences in habitat use in a tropical leaf roosting bat

Corina Logan *based on peer reviews by* **Annemarie van der Marel** *and 2 anonymous reviewers*

Giada Giacomini, Silvia Chaves-Ramirez, Andres Hernandez-Pinson, Jose Pablo Barrantes, Gloriana Chaverri (2023) Consistent individual positions within roosts in Spix's disc-winged bats. bioRxiv, ver. 3, peer-reviewed and recommended by Peer Community in Ecology.
https://doi.org/10.1101/2022.11.04.515223

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Consistent individual differences in habitat use are found across species and can play a role in who an individual mates with, their risk of predation, and their ability to compete with others (Stuber et al. 2022). However, the data informing such hypotheses come primarily from temperate regions (Stroud & Thompson 2019, Titley et al. 2017). This calls into question the generalizability of the conclusions from this research until further investigations can be conducted in tropical regions.

Giacomini and colleagues (2023) tackled this task in an investigation of consistent individual differences in habitat use in the Central American tropics. They explored whether Spix's disc-winged bats form positional hierarchies in roosts, which is an excellent start to learning more about the social behavior of this species - a species that is difficult to directly observe. They found that individual bats use their roosting habitat in predictable ways by positioning themselves consistently either in the bottom, middle, or top of the roost leaf. Individuals chose the same positions across time and across different roost sites. They also found that age and sex play a role in which sections individuals are positioned in.

Their research shows that consistent individual differences in habitat use are present in a tropical system, and sets the stage for further investigations into social behavior in this species, particularly whether there is a dominance hierarchy among individuals and whether some positions in the roost are more protective and sought after than others.

References:

Giacomini G, Chaves-Ramirez S, Hernandez-Pinson A, Barrantes JP, Chaverri G. (2023). Consistent individual positions within roosts in Spix's disc-winged bats. bioRxiv, https://doi.org/10.1101/2022.11.04.515223

Stroud, J. T., & Thompson, M. E. (2019). Looking to the past to understand the future of tropical conservation: The importance of collecting basic data. Biotropica, 51(3), 293-299. https://doi.org/10.1111/btp.12665

Stuber, E. F., Carlson, B. S., & Jesmer, B. R. (2022). Spatial personalities: a meta-analysis of consistent individual differences in spatial behavior. Behavioral Ecology, 33(3), 477-486. https://doi.org/10.1093/beheco/arab147

Titley, M. A., Snaddon, J. L., & Turner, E. C. (2017). Scientific research on animal biodiversity is systematically biased towards vertebrates and temperate regions. PloS one, 12(12), e0189577. https://doi.org/10.1371/journal.pone.0189577

Reviews

Evaluation round #2

DOI or URL of the preprint: https://doi.org/10.1101/2022.11.04.515223
Version of the preprint: 2

Authors' reply, 23 November 2023

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Decision by Corina Logan, posted 17 November 2023, validated 20 November 2023

Minor revision

Thank you very much for your thorough revision and response. I sent the manuscript back to two of the previous reviewers and both are very positive. One reviewer has some minor comments to address. Once you have addressed these and resubmitted, I will be happy to recommend your article

All my best,
Corina

Reviewed by Annemarie van der Marel, 08 November 2023

Download the review

Reviewed by anonymous reviewer 1, 16 November 2023

I thank the authors for the replies to my suggestions and comments, and for taking them into consideration when working on the manuscript.

In my opinion, the manuscript improved clearly in this version, and all the changes were important to it.

I do not have any further comments or suggestions to it.

The manuscript is clear as it is and all the predictions, results, discussion and arguments sound reasonable.

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.1101/2022.11.04.515223
Version of the preprint: 1

Authors' reply, 20 October 2023

Download author's reply
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Decision by Corina Logan, posted 12 December 2022, validated 12 December 2022

Major revision

This is a welcome piece of research that sheds light on an understudied system in the tropics, which are understudied in general. Exploring whether Spix's disc-winged bats form positional hierarchies in roosts is a great start to learning more about the social behavior of this species, which is difficult to directly observe. After obtaining three expert reviews, which, among other things, suggest improvements to terminology and the analyses, I would like to invite a major revision. Please address all reviewer comments, and my comment below, and submit your revision along with point by point responses to each comment. I will then send it back to a subset of reviewers.

I look forward to reading the revised version.

All my best,
Corina

Line 219: suggest how to measure social dominance rank in future studies because using the word dominance here could be confusing with how you measured dominance in this study, which was not about social dominance rank, but rather physical position. See reviewer 1's suggestions for how to rename this term.

Reviewed by Annemarie van der Marel, 08 December 2022

The authors set out to study whether Spix's disc-winged bats use preferred roosting positions in their roosting sites in tubular leaves. They found that these bats use certain positions consistently within a roost, where adult males or subadults occupy the top position more often. The authors then speculate that this may suggest a difference in resource holding potential for each roosting position and that certain positions are contested over, which may result that dominance influences which bat is able to roost at a certain location.

I enjoyed reading the manuscript that is clearly and concisely written. This study gets at the possibility of studying whether a dominance hierarchy is present in species that are highly mobile, which makes it hard to study the social behavior of these bats. This study therefore presents a good example to get at underlying social mechanisms without actually studying social behavior.

I have one major comment. I'm afraid that the authors do place too much emphasis on dominance throughout the paper, while they do not directly measure it and actually state that at the end of the intro (line 89-91) and highlight that in the discussion (lines 249-252). I think that if the authors want to use dominance throughout the ms, they will also have to study whether the position in the roost are fought over by the bats. As the definition of dominance is the relationship between two individuals which can be explained that one individual (the subordinate) will submit to another (dominant) individual in contest situations (Kaufmann, 1983). The dominance measure (lines 146-153) is not really dominance in this sense, and I think the authors could get at the question whether individuals use specific positions using a different method (see below). So, I would place less emphasis on dominance, as the paper tests whether bats prefer certain locations within a roost,

not whether these locations are contested over. The authors can then use the results presented here to only discuss the possibility of dominance in these bats.

Also, before performing the linearity analysis, I would first like to see the basic measure of the number or proportion of times each individual per social group is located at each position. Then the authors can randomise the locations 100 or 1000 times and compare the observed proportion to the expected. This method would allow the authors to see whether the individuals use the same locations repeatedly or whether roost positions are random. This method is more direct to getting at whether there are consistent individual positions within roosts as highlighted in the title then using dominance. As of now, I find the title a little misleading as the authors do not directly answer consistent locations within the roost. The authors can use the linearity measure to test whether there is a certain preferred direction of roost positions. I would remove the David's score altogether. Perhaps what would work better is creating a matrix of the different positions and then including the number of times adult females are occupying each position. A different matrix is created for adult males and then a mantel matrix correlation test can analyse whether these positions differ between sexes. The same can be done with age classes and vocal bats. I'm not certain whether this is the right method here but to me, it seems to get at the questions more directly of consistent individual positions within a roost and who occupies those positions than the linearity and david's score measures.

Please find line-to-line comments below.

Line 37-40: This is too much of a speculation. Please consider ending the abstract with a significance statement of the results provided in the paper not a speculation of the factors potentially explaining the finding.

Line 53: what is meant by this? The spatial position or consequences of social living. Please provide a noun after this

Line 62-63: I would also think that attack strategy has an influence. A bird of prey could also attack individuals in the middle of a group, while an ambush predator would have better luck on the periphery.

Line 64-65: as this is a general intro sentence, the authors could decide to include other examples besides roosting in bats, such as ground-dwelling rodents that rest in burrows, birds in their nests, and hibernating animals. Please also include references.

Line 67: "Roosts have heterogeneous internal conditions," Please provide a citation.

Line 69-70: This is a very sudden change in direction. Consider moving this sentence to after line 74 of the examples.

Line 71-74: Can you provide the ref for each specific example, so that the reader knows which one belongs to which study? Also, the authors can remove the filler words "it has been found that"

Line 80: Are these bats nocturnal? This would also provide another reason to study location in roost sites as it is hard to observe social behavior of nocturnal animals.

Line 84=86: Do the bats use one specific plant or multiple different plants? Please also provide some specifics about the plant species. And just out of curiosity, the bats can use the leaves for max one night?! Is it difficult for the bats to find suitable roost sites or are these specific plants very common and provide ample opportunities for the bats to find a new roost site daily?

Line 87-91: I like the explicit mention that the authors do not study the function of the different positions and that this study allows the development of novel hypotheses. See also my major comment.

Line 99: As the authors do not study dominance directly, I would not use dominance here. Instead, just mention that females and adults will occupy certain positions more than expected.

Methods

Line 120: "...are considered to belong...'

Line 124: how did the authors trap the bats?

Line 128-130: A little more info about the vocalization recording would be helpful and then refer to the ref if readers require more detail. Right now, I'm curious how long you would record for if the observers just noted it down or also recorded the vocalizations, whether you can identify which bat is calling within the roost site. I like to know these things without having to read another paper.

Figure 1: Love the drawing!

Line 136: I would first like to see whether the bats consistently position themselves in the same spot without any 'dominance' measures. See major comment.

Line 139: it's a little misleading as I would think that the first one to enter the roost would be positioned on the bottom, so I would say 'bat a is always in the bottom'. If I'm wrong, please clarify.

Results

Figures: the figure quality is not really great.

Figure 2: Can the authors also include the observed data points? Perhaps using a raincloud plot instead. I would also change the x-axis legend as it is now not clear whether bottom means starting at the bottom, etc

Discussion

Line 216: Can you also restate which positions are preferred by sex and age class?

Line 219: can you provide the refs for the 'other studies'?

Line 230-232: Could there also be a thermal advantage for being in the middle or does that not matter for bats in Costa Rica?

Lines 234-242: This is quite speculative. I would not create a whole paragraph on a situation that may or may not be. Perhaps it's primarily the affiliative relationships that decide where each bat will be positioned. Instead, the authors can state something along the lines of 'further research is required, to study the costs and benefits of certain positions as this may further highlight the possibility of a resource holding potential and a dominance hierarchy in these bats.

Line 243-244: I would not start this paragraph with this sentence. Instead, first state your results and then discuss the implications.

Line 252=258: consider making this its own paragraph.

Line 265-266: this is the first time mentioning the function of roost sites. Consider moving this already to the intro when introducing roosting in bats and highlighting the function in a separate paragraph in the discussion, perhaps instead of the dominance paragraph (lines 234-242).

Reviewed by anonymous reviewer 1, 06 December 2022

This work uses a bat species that has a roosting tubular structure (the Spix's disc-winged bats) to understand whether there is a predictable and consistent individual position in their linear structure within the roost, as the species switches roosting places daily and has to re-arrange themselves among the tubular structure after a switch. It was found that the position of bats within the roost is consistent and influenced by sex and age, but not their capacity to be vocal. The authors discuss these results considering a possible influence of dominance hierarchies in the position of individuals within the roost.

In general I found this study interesting with valuable data that will contribute to better understand how consistent positions within groups may be formed. Studies on this topic seems to be scarce, especially in bats, but the particularities of this bat's species make this study highly interesting and with a neat evidence of consistent position of individuals within roost. However, in my opinion, the manuscript would benefit from some further explanations and clarity in the methodology, especially for the statistical analysis. I made suggestions and comments for that in turn. I hope the authors find them useful.

Major comments:

1) I highly missed details in the description of the statistical analysis. Perhaps I am not familiar with the Bayesian test applied, but I think that more complete descriptions and an explicit definition of the models used will improve the possibility of other researchers to replicate analyses. For example, it is not clear to me how repeated measurements of different groups entered the model. I also do not think it is clear whether sex, age and vocal capacity were considered together at the same model or not.

In line 168 is seems to indicate that only one individual per group was considered. But in line 154 it seems to indicate that linearity and dominance were computed per group only, and not individual. However, if the

latter I am not sure whether repeated measurements were included already in this point. So, I am not sure to be reading this well, but if only one individual per group was considered why not include all individuals in each group, controlling for variation within groups? Again, if more detail regarding analysis can be given it would be highly valuable to the manuscript.

Furthermore, if the authors only used one value per individual and per group did the authors tested for the consistency/repeatability of the individuals' position across the different sampling periods?

Finally, in line 171, does this refers to evaluation of the expected value under each null hypothesis? In that case, was the null hypothesis computed with the Bayesian binomial test and the expected values are according to the data (proportion of females = 0.57 in the collected data). Please clarify.

2) I suggest clarifying the meaning of the measurements. In line 146 it is described how dominance was calculated, but then in line 250 it is assumed that the results do not indicate dominance hierarchy or dominance per se because it was not computed from aggressive interactions. I agree with this interpretation, which is reasonable, however I think the authors should state clearly from the beginning how this dominance measurement will be interpreted. Otherwise, the different parts of the manuscript may be a little contradictory.

3) The authors present results for linearity measure (line 183: "linearity was greater and less variable when calculated from bottom to top positions"), however no statistical analysis seems to be described regarding this result. Did the authors assessed this only looking at Figure 1? If so, that should be explicitly stated. In any case, if no statistical test was performed, I think the authors can test whether the variance and values statistically differ among categories.

Minor comments:

Line 59: please mention in which direction predation rates may be affected by their position.

Line 100: I think the sentence would read better this way: "we predict that dominance over positions within the roost will be primarily assigned to adults and females, which are larger than males"

Line 130: please briefly explain the method used to quantify vocal behaviour

Line 140: was linearity computed per individual per scan or per individual across all scans? More details at which level was linearity (and other measurements) computed could help to clarify analyses.

Line 184: typo, Figure 2

Line 191: does supplementary table presents the data? If so, it could be mentioned here.

Line 197: In the end of the sentence, I think it is missing a reference to Figure 3.

Line 201: typo, Figure 3

Line 212: this sentence mentions previous studies but does not mention the references to them. It could also be useful to include the taxa or species studied to understand whether this is reported to happen in a specific taxa or species only.

Line 253: are these previous studies also in bats?

Reviewed by anonymous reviewer 2, 12 December 2022

This an extremely well-written paper that explores an interesting aspect of relative spatial positioning, namely the positions occupied by different age-sex classes of individual Spix's disc-winged bats within a tubular leaf roost. Its findings are a relevant addition to this literature base, although only ten social groups were sampled; it is not clear how representative a sample this is, or how these groups were selected.

The introduction provides adequate context and justification for the study. The Methods could be improved by adding a little more information, as outlined below, to help the reader understand exactly how this study was conducted. The figures in the Results section are very clear and useful to the reader to understand the study's findings.

Minor edits suggested would be to include a little more information regarding the leaf roosts in line 85 (do these only last for one 24 hour period? Why?). In line 124, please clarify what is meant by the "first encounter", and give more details about trap and release procedure; how much time was left between captures and data collection? Could trapping affect individuals' behaviour in the short-term? In the Methods section, please give further information on sampling effort – you give the dates of data collection, but the reader has no information on how frequently sampling was carried out. It would also be helpful to give information about this species' life history – was sampling carried out during the breeding season, for example? In the Results section, you mention ten groups were sampled. Is there any information on population size so the reader can determine whether this was a representative sample? What about the population's range – what proportion of this was sampled? Line 184 – figure name missing; line 201, incorrect figure number. Line 226 – can you give the reader and idea of the types of predators bats are at risk from and perhaps their likelihood of attacking from either below or above, if this information is known?