



## Investigating flower–insect interactions in Sahelian ecosystems: the role of *Balanites aegyptiaca*

**Marta Galloni**  based on peer reviews by **Rosa Ranalli**, **Bjorn Bartholdy**  and 1 anonymous reviewer

Natalia MEDINA-SERRANO, Anne-Genevieve Bagneres, Mouhamadou M. Ndiaye, Valentin Vrecko, Doyle McKey, Martine Hossaert (2026) Seasonal variation in insect assemblages at flowers of *Balanites aegyptiaca*, an ecologically and socially important tree species in the Ferlo region of Senegal's Great Green Wall corridor. bioRxiv, ver. 4, peer-reviewed and recommended by Peer Community in Ecology.

<https://doi.org/10.1101/2025.03.26.645493>

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The Sahelian thorn-bush savanna, located between the Sahara Desert and southern woodlands, is one of the world's most environmentally degraded regions and is extremely vulnerable to climate change. Nevertheless, restoration initiatives implemented so far have been mostly plant (tree)-based, largely neglecting biotic interactions, which remain critically understudied.

Medina-Serrano et al. (2026) address this gap by investigating flower–insect interactions in Ferlo, a semi-arid sylvo-pastoral region in northern Senegal. This study provides a first assessment of the diversity of flower-visiting insects associated with *Balanites aegyptiaca* (L.) Delile (the desert date; Zygophyllaceae), a keystone and economically important tree species common in the region.

This work is particularly noteworthy for its methodological approach and ecological scope, especially given the lack of a comprehensive framework for restoring pastoral ecosystems in the region. The study was conducted across different periods of the year to capture temporal variation in flower-visitor communities in this highly seasonal environment. In addition, although spatially limited, it is valuable that monitoring was performed at sites differing in their management history and ecological characteristics. By combining complementary sampling techniques (hand netting and pan traps) across different sites and seasonal periods, the authors provide a robust and well-structured dataset. The comparison between restored and unrestored areas within the framework of the pan-African Great Green Wall initiative adds important applied value, offering insights

into the ecological outcomes of large-scale restoration efforts.

The results reveal a remarkably high diversity of flower-visiting insects (overall, 2,907 individuals sampled, representing at least 371 morphospecies across 10 orders). As expected, different pollinator assemblages were captured by the two methods, partly reflecting the ecological habits of some taxa (e.g. nocturnal moths were mostly pan-trapped), underscoring their complementarity. The authors report the spectrum of *Balanites aegyptiaca*'s floral visitors, indicating their ecological roles. Key functional groups include solitary bees (notably Halictidae, present in all seasons) and some families of small flies (Diptera) as likely major pollinators, while ants—the most abundant visitors, with 10 different morphospecies—can act as nectar consumers or predators. Importantly, the study goes beyond pollination by illustrating how floral visitors contribute to a wide array of biotic interactions, including herbivory, decomposition, parasitism, and predation. These results highlight the ecological importance of the desert date in sustaining multiple trophic interactions, likely due to its year-round flowering and its “open” flowers, which offer easily accessible rewards to a wide range of insects.

The data analysis demonstrates strong seasonal variation in the abundance, diversity, and species composition of flower-visiting insect assemblages. The study also reports a slightly higher insect abundance in the Restored site, while observed species richness is significantly higher in both the Restored site and the Depression area compared to the intensively grazed Unrestored site, suggesting the likely importance of topographical depressions in this region as refuges for diverse organisms. Even though these findings provide limited insight into the effects of restoration actions on flower-visiting insect assemblages, when integrated into a broader ecological context they emphasize the role of year-round floral resources in maintaining biodiversity under extreme environmental conditions.

This manuscript underscores the importance of understanding and preserving biotic interactions to mitigate ecosystem degradation and support large-scale restoration initiatives such as the Great Green Wall. This integrative perspective significantly enhances the manuscript's relevance for both fundamental ecology and applied conservation, providing a promising foundation for future long-term research aimed at improving our understanding of this system. Overall, I find this manuscript scientifically relevant to current challenges in biodiversity conservation and ecosystem restoration in the context of climate change.

### References:

Natalia MEDINA-SERRANO, Anne-Genevieve Bagneres, Mouhamadou M. Ndiaye, Valentin Vrecko, Doyle McKey, Martine Hossaert (2026) Seasonal variation in insect assemblages at flowers of *Balanites aegyptiaca*, an ecologically and socially important tree species in the Ferlo region of Senegal's Great Green Wall corridor. bioRxiv, ver.4 peer-reviewed and recommended by PCI Ecology  
<https://doi.org/10.1101/2025.03.26.645493>

## Reviews

### Evaluation round #3

Reviewed by **Bjorn Bartholdy** , 24 March 2026

#### Data editor's report

Date: 19/03/2026

#### 1. Data and metadata must be archived and adhere to FAIR guiding principles

[x] Data are in a public repository

[x] Data repository has a persistent identifier (e.g., a DOI)

[x] Data are cited in the manuscript (in data availability statement or similar, as well as in the Literature Cited)

[x] Data repository has a license

[x] All necessary data files are present in the repository

[x] All raw data present

If not:

[x] Information on where raw data are located

[x] Information about how to access the raw data

[x] Sufficient information about database version/filtering/processing/exclusion criteria

[x] All processed data present

[x] Data are contained in an interoperable format

[x] Tabular data - csv, tsv

[x] Metadata present (including README file)

[x] Metadata adequate (including README file)

## **2. Archived data corresponds with the data reported in the manuscript**

[x] Variables used in analysis present in the data

[x] The structure of the data presented matches the manuscript (e.g., it is the right size)

## **3. Code and metadata must be archived and adhere to FAIR guiding principles**

[x] Code has a repository

[x] Code repository has a DOI

[x] Code is cited in manuscript

[x] Code repository has a license

[x] Code files are present in the repository

[x] Code is contained in an interoperable format

[x] Metadata present (README file and annotations in code)

[x] Metadata adequate

## **4. Archived code matches the manuscript**

[x] Code is present for all analyses in the manuscript, along with code used to produce figures/tables where appropriate

## **5. Archived code runs with the archived data**

[x] Runs without errors

## **6. Results can be computationally reproduced by running the archived code**

[x] Numeric results (in table or text)

[x] Figures

[x] Supplementary Figures

[x] Supplementary Tables

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Comments from the data editor:

Much improved structure. Results are easier to find in the scripts. The code could benefit from an environment manager (like renv) as there will likely be version conflicts in packages in the future, but for now it works.

[Download the review](#)

## Evaluation round #2

DOI or URL of the preprint: <https://doi.org/10.1101/2025.03.26.645493>

Version of the preprint: 2

### Authors' reply, 13 March 2026

Dear recommender,

I uploaded the response letter and the PDF version of the document with track changes. If needed, I can send the Word version through a link, since the .docx file makes the track changes easier to see, but it is too large for the upload option.

Best,

Natalia

[Download author's reply](#)

[Download tracked changes file](#)

### Decision by [Marta Galloni](#) , posted 11 January 2026, validated 12 January 2026

Dear Authors,

Thank you for addressing the reviewers' comments and for improving your manuscript.

Nevertheless, some issues still need to be considered before I can recommend it, as outlined in the second-round review. Please find the referee's suggestions below.

I kindly ask you to make a final effort to implement these minor revisions in order to improve readability and enhance the impact of your paper.

Please revise the text using track changes, and provide a point-by-point response to each comment.

I look forward to receiving your revised manuscript.

### Reviewed by anonymous reviewer 1, 24 December 2025

Title and abstract

Does the title clearly reflect the content of the article? [x] Yes, [ ] No (please explain), [ ] I don't know

Does the abstract present the main findings of the study? [x] Yes, [ ] No (please explain), [ ] I don't know

Introduction

Are the research questions/hypotheses/predictions clearly presented? [x] Yes, [ ] No (please explain), [ ] I don't know

Does the introduction build on relevant research in the field? [x] Yes, [ ] No (please explain), [ ] I don't know

Materials and methods

Are the methods and analyses sufficiently detailed to allow replication by other researchers? [x] Yes, [ ] No (please explain), [ ] I don't know

If applicable (for empirical studies), are sample sizes clearly justified? [x] Yes, [ ] No (please explain), [ ] I don't know

Are the methods and statistical analyses appropriate and well described? [x] Yes, [ ] No (please explain), [ ] I don't know

Results

In the case of negative results, is there a statistical power analysis (or an adequate Bayesian analysis or equivalence testing)? ☐ Yes, ☐ No (please explain), ☐ I don't know

Are the results described and interpreted correctly? ☒ Yes, ☐ No (please explain), ☐ I don't know

#### Discussion

Have the authors appropriately emphasized the strengths and limitations of their study/theory/methods/argument? ☒ Yes, ☐ No (please explain), ☐ I don't know

Are the conclusions adequately supported by the results (without overstating the implications of the findings)?

☒ Yes, ☐ No (please explain), ☐ I don't know

#### Revision

I would like to thank the Authors for their efforts and for thoroughly revising the manuscript following the suggestions made by the two Reviewers. Although it has been greatly improved, I believe that some parts of the manuscript still need a few changes before it can be recommended. These are minor comments, which I believe can be easily implemented and which I hope will help to clarify certain points and make the text easier to read.

#### Abstract

L16-17: I would suggest rephrasing as follows: Studying insect-flower interactions may thus be strategic to conserve and restore ...

L19-20: I think the sentence "Very little [...] in this region" is not very informative and could be removed.

LL20-22: This sentence could be then linked to the previous by changing:

in the northern Sahel -> in this region

restoration efforts of the Great Green Wall initiative have -> the Great Green Wall restoration initiative has

L24-25: I would rephrase this sentence "This species [...] economically important" as follows:

This is the most abundant tree species in the region and is also of economic importance.

L37-39: I don't understand this sentence. Flower-visiting insects were available to ants? What does this mean? You could probably rephrase to simply state that Flower visiting ants were especially abundant in the dry season.

Not relevant anymore, but also spelling: occurring -> occurring

#### Introduction

L112: space between ". and Our research"

L113: just keep GGW (remove Great Green Wall)

L165-168: These points are not very clear to me. I would suggest to rephrase to state something like "We present (1) an overall analysis of the taxonomic and functional diversity and abundance of flower-visiting insects, (2), an assessment of ..." on what? Please make it clear.

#### Materials and Methods

Fig.1 legend: I would rephrase this sentence in "Satellite photograph of the Koyli Alpha landscape taken in 2019..."

Also, what does "Alt 9.44 km" indicate? If it's a satellite photo, it can't be the altitude of the satellite... Is it a zoom made from the satellite photo? I don't think it's actually necessary (but rather confusing), because you already report the scale on the map.

L243-244: please add "active capture ... hand nets and passive captures ... pan traps", to directly inform the reader on the major difference between the two methods (active vs passive).

L251-252: please add information on the time of day in which you performed hand netting (was it a range between e.g. 9 am and 5pm, was it fixed periods,...)?

L255-270: When did you set the pan traps? The first day of hand netting, or the second (because you performed hand netting for 3 days, but set pan traps for 2 days)? You might for example add this information in L258 instead of 48h, which is repeated below in L265.

L271: did you also change the three trees used for pan traps? If that's the case, I would simply say "The flowering trees sampled were often not..."

L272: abundance of open flowers, I think?

L283-285: please remove the sentence "In each site, five individual trees were sampled" to avoid repetition, you already said it above. The last sentence could be rephrased to state that the sampling effort in terms of number of trees was determined based on the availability of individuals with abundant flowering ( $\geq 10\%$  of...), or something similar.

L292-294: unclear, I suggest rephrasing as "All determinations were made at the family or lower taxonomic levels using Aberlenc keys. For Hymenoptera, we used online keys in Atlas Hymenoptera (link)". Also, I think it's just Atlas Hymenoptera, not Atlas of Hymenoptera.

L303: "from our analyses", not "in our analyses"

L316: add a space between were and based

L344: Instead of "to calculate estimated true..." you could just say "to estimate true..."

L380: change INEXT with iNEXT

L386-388: repetition, you already said this in the methods. Please remove the sentence "Hand-net sampling ... these trees" and rephrase the following sentence as "To allow comparison between hand-net and pan-trap samplings, ..."

L387-390: Based on your pan-trap standardisation, shouldn't you also divide the hand-net samplings by five, to have the average sampling by tree as well? How can you compare 5 trees with 1 tree? Or maybe it's what you did and you need to rephrase this sentence?

L392-394: The first sentence is unclear. Please rephrase "Differences in ... among sites were analysed K-W tests". Remove the second sentence from here, it's a result (so put it in the Results section).

L394-397: avoid repetition and improve clarity. You could rephrase as "We then fit separate GLMs by season and site, to test the effect of local tree density (...) and canopy flower percentage on ..."

L397-403: These are all results, they shouldn't be reported here.

L403-404. I'm not sure this sentence is needed, and it's not clear to me which are the covariates being excluded and in which models. If you think it is, please rephrase it to read something like "Because ... and ... were not ... (see results), they were excluded from ..."

L404: To assess...

GENERAL COMMENT for this section (d Covariates): I am not sure that using the word "covariate" is correct here. From what I understand, you are considering them as two independent explanatory variables, so please rephrase all these sentences where you are using the word "covariate". Be explicit in saying which variables are used for each model, as sometimes it's difficult to follow your process.

L417-431: Please remove all of this. It's just a repetition of what you explain in more detail below.

L443-444: I think the correct citation for the R package 'car' is Fox & Weisberg 2019 (Fox J, Weisberg S (2019). *An R Companion to Applied Regression*, Third edition. Sage, Thousand Oaks CA. <<https://www.john-fox.ca/Companion/>>.)

L462: please remove, it's a repetition.

L487: please cite the authors of the vegan package Oksanen et al. 2025 (Oksanen J, Simpson G, Blanchet F, Kindt R, Legendre P, Minchin P, O'Hara R, Solymos P, Stevens M, Szoecs E, Wagner H, Barbour M, Bedward M, Bolker B, Borcard D, Borman T, Carvalho G, Chirico M, De Caceres M, Durand S, Evangelista H, FitzJohn R, Friendly M, Furneaux B, Hannigan G, Hill M, Lahti L, Martino C, McGlinn D, Ouellette M, Ribeiro Cunha E, Smith T, Stier A, Ter Braak C, Weedon J (2025). *vegan: Community Ecology Package*. doi:10.32614/CRAN.package.vegan <<https://doi.org/10.32614/CRAN.package.vegan>>, R package version 2.7-1, <<https://CRAN.R-project.org/package=vegan>>.)

L489-495: I don't understand this paragraph. First you say you tested each order and family, then the main flower-visitor orders, and then only three Hymenoptera families. So, what did you do? Three different models? Why, and how do they differ? It's not clear.

## Results

Figure 3: please update the legend within the figure to say "Hand net total abundance"

L509-511: unclear, please rephrase with something like "Table 1 presents the orders and families of flower-visiting insects encountered in the study, and the functional categories we used to describe them"

L515: what does the "See also Tables..." refer to? Please specify why we should see them. Please also add in the legend that the column "Likely important pollinators" refers to families that you consider to be likely pollinators based on ...

In the table column "Functional group", what do you mean by "diverse" for Diptera, and "generalist" for Formicidae

L520-522: Just a curiosity, why do you think so many moths fell into the pan traps? Don't moths mainly rely on volatile compounds rather than visual cues?

L534-537: remove, this is already in the methods

L543-544: from Figure 4, it seems that mid-dry and rainy seasons were switched in the text.

L546-547: How is that so? From Figure 4, it seems that mid-dry is consistently higher than dry (both rarefaction and extrapolation)

L551: you forgot the (b) before "Comparison of observed and ...

L562-565: no need to repeat methods. Please remove.

L568-570: I don't think that using "the seasonal effect" is clear. You mention earlier that the effect was significant only when considering seasons, so please rephrase accordingly.

L572: instead of covariates, please state which variables you excluded.

L576: remove, it's a repetition of the methods

Figure 6: Didn't you use  $\log(x+1)$  in the analyses? Here you are reporting values for  $\log_{10}$ .

L642-643: I think this sentence belongs more in the discussion than in the results section

Figure 7 legend: I can't see any asterisks, and from the methods section it seems like you didn't do any analyses on this. Please remove this sentence from the legend

L654: I would add that both Diptera and Hemiptera showed differences between end-dry and mid-dry seasons (not just Diptera, since they share the same patterns).

L681-685: interesting, but it belongs in the discussion section rather than the results section.

L745-748: thanks for adding references. On second reading, I would like to ask you to slightly rephrase these two sentences, because it seems that soil fungal pathogens are the solely parameter acting on the rarity/abundance of ground-nesting bees. I would suggest something along these lines "Moreover, unlike tropical eusocial bees, solitary bees mainly nest in the ground (ref). Such abundance of ground-nesting species in the study area may be related to the rarity of soil-dwelling fungal pathogens in arid environments (ref)."

L757: I suppose these are codes for the morphospecies as they appear in the Dataset. Please add information about this, for example as "(morphospecies halict 1, 2, 3) ... (morphospecies halict 17)"

L835-836: I find this sentence too difficult to read. Here's a suggested rephrasing: "One family of Diptera whose abundance and limitation to the rainy season can be easily explained in terms of larval resources is the Rhinophoridae."

Figure S4 legend: net -> hand net, and please add R before "package entropart".

Figure S5: I would suggest removing the p-value from the figure ( $p = 0.00082$ ), as it refers to the overall K-W analysis. If you are bale, I would add the significant pairwise p-values as you did in figures in the main text (and in Figure S6).

Figure S6: I'm surprised that in the mid-dry season (third plot), Depression site is significantly different from the Restored but not the Unrestored site. Can you confirm it's correct?

## Evaluation round #1

DOI or URL of the preprint: <https://doi.org/10.1101/2025.03.26.645493>

Version of the preprint: 1

### Authors' reply, 26 November 2025

[Download author's reply](#)

### Decision by **Marta Galloni** , posted 15 July 2025, validated 15 July 2025

Dear Dr. Medina Serrano and co-authors,

Your article has been evaluated by two experts in the field. Both reviewers recognize the novelty and relevance of your study for scientific and conservation purposes. However, they have also raised some concerns about the structure of the manuscript, particularly in the Methods and Results sections, and have provided detailed suggestions to improve it.

I am confident that addressing these points will significantly strengthen your article. Therefore, I kindly ask you to carefully read the reviewers' reports and revise the manuscript accordingly, responding to each point raised in a point-by-point manner.

Thank you for submitting your work to PCI Ecology. I look forward to receiving your revised version.

### Reviewed by anonymous reviewer 1, 16 May 2025

Dear Editor and Authors,

I have revised the article entitled "Seasonal variation in insect assemblages at flowers of *Balanites aegyptiaca*, an ecologically and socially important tree species in the Ferlo region of Senegal's Great Green Wall corridor" by Medina-Serrano and colleagues. This article reports an interesting snapshot of flower visitors of an important and common tree species in an understudied region, especially from the flower visitor/pollinator point of view, in Senegal. I found it remarkable that the work was performed in different periods of the year, which is very important in a highly seasonal environment to capture the temporal variation in flower visitor communities. Though spatially limited, it is also interesting that the Authors included areas that differ in their ecological characteristics and land management, including comparisons between restored and unrestored sites. I think this could be a very interesting starting point for future, long-term research aiming at increasing knowledge about this system and the species that are involved therein.

I have one major criticism though, concerning the Methods and Results sections. I found it often quite difficult and confusing to follow the text. Different sections are reported in different orders: for example, in the Methods section the first analysis mentioned concern diversity indices, then rarefaction curves and species richness, then models on abundance and diversity between seasons and sites. However, in the Results section, the Authors first report results of models on overall patterns, then separate differences between seasons and sites, and therein present first diversity indices, and then rarefaction curves and richness data. I would strongly suggest to re-structure these sections to follow a more linear pattern, that could be linked more easily by the reader when going through the text, without needing to jump from one method to the other and between sections. Methods could also be clarified in some points, as I detail below. I also think Authors should include all methods and results in the appropriate sections: for example, Sørensen and Kruskal-Wallis analyses and Figures S6-S7 are only mentioned in the Discussion, without any background on them in earlier sections. I was also wondering, why not include a model (GLM) considering the interaction between season and site, instead

of analyzing separate models? As the Authors show differences between the two, I think this could take into account both at the same time, reducing the number of models needed to analyze data.

I hope these suggestions will help make this interesting article stronger and easier to read.

Here are my specific comments for each section, with references to Line numbers.

#### Abstract

L36: This was not very clear to me. I think it could be rephrased to "Diptera, in particular several families of small flies, ..."

#### Introduction

L93: please add the acronym (GGW) after "Great Green Wall", to clarify its use throughout the paper.

L104: It would be interesting to add one or two references here (after "principally planting trees and encouraging their natural regeneration") to show what has been done so far concerning revegetation (as it's also mentioned in line 98 without references).

L116: either use GGW or keep the full name. I also think it would be useful to add one or two sentences to briefly introduce the aims and context of the GGW initiative, as I suspect many readers - including myself - may not be familiar with it, and it would give a larger focus to the paper.

L128-131: a suggestion to slightly modify these three sentences: "Furthermore, the activity of some insects peaks in the wet season, while others peak in the dry season (Kishimoto-Yamada & Itioka, 2015). Most studies of insect seasonality have compared rain forests and tropical dry forests (e.g., "add references here"). Few have been done in the savanna (add references), and to the best..."

L144-146: A few references that might be interesting to cite about *B. aegyptiaca*'s ecology and uses, also in L229-231 and that paragraph in general (though some refs are reported at the end of the paragraph):

<https://saharaconservation.org/news/profile-of-a-tree-the-desert-date-balanites-aegyptiaca/>

<https://popups.uliege.be/1780-4507/index.php?id=11647>

<https://j.ideasspread.org/index.php/ijas/article/view/1197>

<https://www.sciencedirect.com/science/article/abs/pii/S037811279290311V>

L161-162: I don't understand how this question (Does the extreme seasonality of precipitation in our study area impact the abundance, diversity, and species composition of insect assemblages?) is different from Question 1 (How does seasonality influence the abundance, the diversity, and the composition of assemblages of flower-visiting insects?).

#### Materials and Methods

L195: Elsewhere savanna is written without the h at the end.

L247: I would suggest using "hand net" instead of just "net", here and everywhere appropriate in the text. It is more precise, and the use of net could be misunderstood on some occasions.

L250: What do you mean with daily? If it's "during the day" you should change it. Otherwise just remove it, as then you say you sampled for three consecutive days, not every day of each sampling month.

L252: Fifteen minutes in total, i.e. 3 minutes per tree on average, or 15 min per tree? Fig. 2 says it's per tree. I would add this information here as well.

L253: Once in each of the three seasons (so three sampling events of three days each), correct? You mention the three seasons below, but please add this information here to clarify and be more precise. I would also say "over three consecutive days" instead of "successive days".

L255: In the parenthesis, I would add (white, yellow, or blue, one of each colour) to be more precise.

L257: When you say mid-canopy level, do you have a range of height, such as for the hand netting? It would also be interesting to explain how you attached the pans to the tree branches, as it's not something very

commonly done - it could help future research.

L260: please add information on where/how stored the sampled insects before bringing them to the lab for identification.

L266-267: Did you also record if these other plants had flowers? It could have counted as co-variable in the number of insects sampled on a focal tree.

Figure 2: add hand net in the caption.

L287: Is Aberlenc 2021 a field guide? Does it have keys or did you compare photographs/drawings?

L289: First six letters and unique number IDs?

L295: Verified by whom? As you mention some groups, can you be more precise on who verified the other ones, for example including Hymenoptera (bees, ants, ...), which were among the main flower visitors and potentially most important pollinators?

L299: I would remove "collected" after Coleoptera, its' not necessary

L301: please add (Senegal) after Dakar.

L310: It is unclear to me the choice of these "functional" categories. They mix potential ecosystem functions (e.g., pollinators) with biology (e.g., parasitoid and phytophagous).

L326: GENERAL COMMENT: As said in the main comment, I found this section quite confusing. I would suggest you to use a more simple and clear structure, stating what you did, why, and how you implemented each model, and keep it consistent throughout the paragraphs. Now, you often jump from one part to the other, without providing all the detail needed to clearly understand the methods utilized.

L328: Please report the R version as well (e.g., v4.2.1)

L332-335: This is unclear to me. How did you standardise the data before calculating the two indices? Or did you calculate the coverage-standardized indices directly in iNEXT (using the function estimatedD)? Please give a little more detail than just citing the paper for reference.

It would also be helpful to specify why you chose those two indicators and what they tell you (e.g., why not Shannon index, Hill number = 1, which gives equal weight to rare and abundant species?)

Reading further, I saw that you explain why you did not include Shannon in the analyses (L389-392). To avoid confusion, I would suggest removing this part from here and add it in the paragraph L387-392, where you would explain which indices you included, why, and which analyses you performed on them, all in one place.

L339-340: I'm lacking the reason why you're making these analyses. What do they tell you? I also see rarefaction mentioned only here, so it is unclear which methods uses rarefaction. Some explanation would help the reader understand why you used these analyses.

L344, 349, 354, 357: hand net

L365-366: If trees are replicates, shouldn't you include them as random effects to incorporate inter-tree variability (so GLMM rather than GLM)? 5 individuals are on the lower side, but maybe it's enough?

L367: MASS R package (please add the R).

L372: pairwise comparisons between what?

L373-375: Please be more precise about how you built the models. Which are the response variables? Which the explanatory variables? You can refer to Supp Tables, but it would be also helpful to have a sentence explaining the models in the text.

L380: add a space between model and (GLM)

L385: I would simply say "were tested in a second GLM" instead of the full "second model with a Generalised Linear model".

L386: In Table S1 you show the AIC value for the two models, and highlight the first one. Does this mean that you did a model selection? But then you don't show AIC values for further models in the other Tables (and never mention model selection here). Please clarify your methods, and add/remove AIC values consequently.

L387-392: Please consider rewriting this paragraph including information reported in L332-335 (see comment above).

L387: I would suggest consider reformulating “log1p” as “log(x+1)” to be as clear as possible.

L398: Please add: “negative binomial GLM using order or family as response variable, and season (as factor) as explanatory variable”. Or recall every time to Tables where you show the actual models.

L400-401: Only three families because of sample size?

L420: why did you treat season as random effect? What does it tell you (and us)?

L427: Why did you use RDA? What does it tell you different or in addition compared to the GLMs you already did?

Also, add “R” package vegan, and cite authors of the package.

L434: what does “controlling for season mean”? Try to explain it for someone who does not know these models.

## Results

Figure 3: add hand net in the caption (twice).

L452: I think it's “individuals from a total of” (not “of a total of”).

Table 1: hand net in caption.

L470, 477, 481: hand net.

L496: The Sørensen index was not mentioned in the Mat&Met section. Please add it. Also, to my knowledge, it should be Sørensen (o letter with stroke).

L507-508: From figure and Table S2 it seems that the dry season is significantly lower only than February, not August. I find it also confusing that sometimes you refer to seasons but then report months (e.g., Table S2), or keep switching between the two. Because season is what's important, rather than month, I would try to refer directly to it as much as possible.

L512-515: You already explained this in the M&M, so no need to repeat everything here. You can rephrase if you want to shortly mention what this GLM explores, but it's not necessary once you report the results.

L520: I don't understand. Table S2 only shows significant difference between J - F = 0.001, while J - A is 0.06.

L525-526: Then what are you referring to in L519-521?

Figure 5: You might consider switching months with seasons (e.g., End dry season, Rainy season, Mid-dry season), as it is more informative, I would say. Or use “End dry, Rainy, Mid-dry”, and add x-axis labelled as “Season”. Otherwise, I would add a label “Month” on the x-axis, because just using letter J, A, and F is not informative.

L542: you forgot to close the parenthesis after  $p < 0.001$ .

L543: I would mention Table S3 also after values for Coleoptera.

L543-548: I would suggest reporting the direction of the effects rather than just the fact that there was variation, because it is more informative. For example, the three orders showed different patterns, with Hym and Hem showing opposite patterns (highest and lowest abundance in August, respectively), while Dip had intermediate abundance in Aug compared to J and F. Or something along these lines.

L565: Did you forget to report results for Rhinophoridae in Table S4? I don't see them.

L584, 592, 598, 600 and Figure 8: hand net.

L585: If I'm not mistaken, Table S3 reports abundance, not species richness.

L590-591: It doesn't seem to be the lowest, 61 in June is the lowest from what I see.

L291-592: please add Figure 8 after the last Chao richness 230 value.

L597: same, add Figure 8.

L601: I don't see sample coverage in Figure 8.

L611-614: As above, this is methods, not results. No need to repeat everything here.

L617: In table S5 the coefficient is reported as positive. It depends on which one is the baseline site (if it's just based on the alphabetical order of sites, I guess the coefficient should be positive, indicating that abundance was higher in the Restored than in the Depressed site?) Please check and modify accordingly.

L619-622: This is quite confusing, because you are not clearly referring to species richness (LM in Table S5) - but talk about family abundance - and then to abundance or diversity. I don't understand where to look. Please clarify and add reference to the appropriate table.

L625: Again, you are mixing Simpson diversity and richness. Also, please add reference to Table S5.

L635: Is this total richness, summing hand net and pan-trap?

L642: From the figure, it seems that the maximum number of extrapolated species is higher at the Depression than the Restored site.

L644 and Figure 10: hand net.

L654-657: This is methods, not results (please add detail to RDA analysis in the Methods). Also, these two sentences repeat themselves.

L660: Please add a table with coefficients issued from the RDA.

## Discussion

L719-720: I think a reference or two are needed here.

L776: Do you have reference(s) on this dependence on young growth? It's quite specific.

L780: please add reference for Diptera larvae dependence on humid environments.

L815-816: I find unclear the "Diverse other small Diptera" sentence. Did you mean "Other various small Diptera"?

L835: I would suggest rephrasing "nothing seems to be known, or at least has not been synthesised" with a simpler "there is no available information".

L844-846: I would rephrase this differently, as the RDA showed 26% of variation for season, and only 6% (i.e., less than ¼) for sites.

L869: This should be reported in the Results (and Methods) section. See comment to Figure S6.

L873: same thing for Figure S7.

L874-875: Is this reported anywhere?

Also, could it be worth doing a model with interaction between site\*season? It would take care of most of what you did with fewer models, I think.

See suggestion made in comment to Figure S7 (could be applied to both species abundance and richness).

L877: hand net.

L879: Didn't you exclude Shannon diversity from your analyses?

L912-914: Personal taste: I find it difficult to read a paragraph that finishes with a question without elaborating on it. You could add some expectations, or simply rephrase saying that it would be interesting to investigate if trees and forbs present separate subnetworks (modules/blocks) that highlight different structures and functions.

L919-920: Same comment as for the previous paragraph. Consider rephrasing and/or add some considerations.

## References

L1125: This DOI is linked to a different paper: Janzen & Schoener (1968) Differences in insect abundance and diversity between wetter and drier sites during a tropical dry season. Ecology 49:96-110. Which seems interesting and likely appropriate for discussion of this paper, so you might consider including it.

But also please check the correct DOI for this article too (which seems to be <https://doi.org/10.1111/j.1558-5646.1967.tb03416.x>)

## Supporting Information

Figure S1: It could be helpful to show the conversion of inches/0.01 inches in the international scale (cm or mm) in the caption.

Figure S4. Hand net, and add “R” package.

Figure S5: Can you add names of the seasons to the three ellipses, to have a more complete and visual information?

Figure S6: KW test is an overall test among the three sites. You should also do a post-hoc test (Dunn's test, I think) to show the pairwise differences between sites. All of this should be explained in the M&M, and results reported in the Results section.

Figure S7: I don't understand this figure. Sites and months are on the same axis? Colors of boxplots seem to follow those in the other plots (green for Depression, purple for Restored, orange for Unrestored), but that's not what the x-axis says. And where are months? I think the three blocks are months, and colors refer to sites, correct? You should modify the figure accordingly, possibly by adding a color legend for sites in the figure.

I can see the low within-month variability in insect abundance for the Depression sites, but there's also a high variability between months. I find this quite confusing, but I think this should be reported in the Methods and Results section, too.

I also think this pattern could be shown by using a model with interaction between site\*season, to see if abundance between sites was different among the three seasons.

Table S2: In the Formula column there is Season, but then you mention Months in the pairwise comparisons instead of the seasons.

Tables S3-S4: same inconsistency between Season – Months.

## Reviewed by **Rosa Ranalli**, 08 July 2025

**Title and abstract** Does the title clearly reflect the content of the article? Yes

Does the abstract present the main findings of the study? Yes

**Introduction** Are the research questions/hypotheses/predictions clearly presented? No

Does the introduction build on relevant research in the field? Yes

**Materials and methods** Are the methods and analyses sufficiently detailed to allow replication by other researchers? Yes

Are the methods and statistical analyses appropriate and well described? Yes

**Results** In the case of negative results, is there a statistical power analysis (or an adequate Bayesian analysis or equivalence testing)? Yes

Are the results described and interpreted correctly? Yes

**Discussion** Have the authors appropriately emphasized the strengths and limitations of their study/theory/methods/argument? Yes

Are the conclusions adequately supported by the results (without overstating the implications of the findings)? Yes

The article analyses the richness and abundance of insects visiting the flowers of *Balanites aegyptiaca* in the northern Sahel, showing how this species, thanks to its continuous flowering and easily accessible flowers, supports an unexpectedly high diversity of insects that are crucial for pollination and other ecological interactions. The study also evaluates how seasonality and habitat restoration and conservation measures influence the biodiversity of *B. aegyptiaca* visitors. The results underscore the importance of understanding and preserving these biotic interactions to mitigate ecosystem degradation and support large-scale restoration initiatives, such as the Great Green Wall.

The manuscript is well written, clear, and very detailed. The findings are interesting and certainly enrich our understanding of plant–pollinator relationships in this part of Sahel. For these reasons, I believe the study is suitable for publication.

However, I would like to share a few suggestions that might help further improve and streamline the manuscript.

- Since continuous measurements of temperature and humidity were taken, were these variables also tested for their potential effects on species richness and abundance, considering both seasonal and daily variability?
- In the initial analytical sections (e.g., lines 335–352 and from line 581), the data from pan traps and netting are presented separately. In my opinion, these two methods complement each other, providing a more comprehensive picture of pollinator diversity together. The fact that they highlight differences in abundance and species richness is inherent to the sampling approach, which is exactly why both methods are commonly used in combination. For this reason, while a brief comment on the differences between sampling methods (for example referring to Figure 3) is certainly useful, I would suggest presenting the main analyses on the combined dataset without separating the methods.
- Using morphospecies is undoubtedly helpful for defining insect diversity; however, identifying specimens to the species level could make the results even more robust and valuable. It would also significantly increase the contribution of the study by providing a species list of pollinators for a region where such information is scarce. You mentioned that molecular analyses were being used for identification: if these results are already available, it might be worth updating the dataset and including a short section describing this.
- In various parts of the manuscript, you have honestly highlighted some limitations of the study. While this is appropriate, it might be clearer to summarise them all in a dedicated “Study Limitations” section, where they can be stated concisely without detracting from the strength of your results.
- Title: I suggest shortening it slightly and making it more engaging to better capture readers’ interest.
- Abstract: It might be helpful to add a sentence clearly outlining the main objectives of the study.
- Introduction: At the end of the introduction, I suggest clearly listing the three main objectives of the study, you could even number them for clarity. For example: (1) analysis of the biodiversity and abundance of insect visitors; (2) assessment of the effect of seasonality; (3) evaluation of the effect of habitat management. I would also recommend adding a brief sentence summarising the current knowledge gaps on the topic before presenting the objectives, to avoid repeating them throughout the text.
- Other little suggestions:
  - Line 129: Please add a couple of supporting references.
  - Line 282: It would be useful to specify how the specimens were preserved (e.g., stored in ethanol or pinned and dried).
  - Lines 386–388: I appreciate the transparency in reporting that the Shannon index was also tested; however, if the results are not shown or discussed, this part could be omitted.
  - Lines 694–695: Please add relevant citations.
  - Lines 705–706: Consider adding references here as well.
  - Line 708: Please include the full name *Apis mellifera* Linnaeus, 1758.
  - Lines 708–709: Regarding “*Apis*” at the end of the line, it would be helpful to clarify whether you are referring specifically to *A. mellifera* or to the entire genus *Apis*.
  - Lines 735–736: Please add a supporting citation.

Overall, this is an excellent work that addresses a highly relevant topic for biodiversity conservation in the Sahel. I hope these suggestions are helpful, and I look forward to seeing the final version published.

