Dear editor,

Herewith we would like to submit a revised version of our manuscript “Climatic conditions drive the abundance and diversity of spiders community in an Atlantic Forest fragment” (Ref. #14974) to Oecologia Australis. We are pleased that both reviewers think that our manuscript is relevant and have “intriguing and valuable results for the knowledge of spider ecology” (Reviewer 1). We appreciate the all the constructive comments made by the reviewers, and we incorporated all of them in our revised manuscript. Please find below our detailed reply to the reviewers’ comments, and corresponding changes in the manuscript highlighted in red. We hope that in its present form the manuscript is acceptable for publication in Oecologia Australis.

With kind regards, also on behalf of all co-authors,

------------------------

REVIEWERS COMMENTS TO AUTHOR

Reviewer A:

General comments

**A.1.** The article present a intriguing results on effect of seasonal and abiotic factors in the spiders community. In general posses good data, the sample effort is enough robust and have valuable results for the knowledge of spider ecology. I suggest tightly the publication this manuscript, however, some points should be reviewed before publication. Points more serious was on the clarity of objectives, details in methods, statistical analysis and discussion. According title, I expected more on causal relationship of the abiotic factors on spiders diversity (richness, abundance, composition). So some problems should be evaluated and/or clarified in order for the manuscript to be suitable for publication in Oecologia Australis. I've included some suggestions that I think are important to improve manuscript quality. Please, see them below.

**Reply:** Thank you for the very positive and constructive comments; we are glad to know that you tightly suggested the publication of our manuscript. As you can see, we made a throughout restructuration of the manuscript, following all sections pointed by you and the other reviewer. We believe that the quality of the manuscript has improved, especially regarding the ecological implications to a wider audience.

**A.2.** Abstract: Be more affectionate with this session of your manuscript. Define better the question of the your work. There is not hypothesis or goals sentence and conclusion phrase. Your abstract section can be explored with more details, since that be much below of the allowed word number by journal.

**Reply:** We made a throughout restructuration of the abstract, especially because we have new results based on the new analyses that you suggested, and highlighting the ecological implications of our results.

**A.3.** Introduction: Write better the justificative. Not is clear. To have little-study not is the better justificative. I want know what need be done, what is known and what is not known (paragraph 4).

**Reply:** This problem was also pointed by the other reviewer. We improved our introduction by removing some paragraphs that were not related to our aims, and explicating the relationships between climatic data and spider communities attributes.

**A.4.** Introduction: You need improve the theory background and reforce in the introduction.

**Reply:** Please see our previous reply.

**A.5.** Introduction: It is not clear in the aims if the work is about either a spider species list, what makes his a descritive work, or about spiders communities ecology.

**Reply:** We rephrased our aims and hypothesis as you can see. We believe that both have improved in clarity: “*In this study, we conducted the first standardized inventory of spiders in a fragment of a Araucaria Forest in the center-south region of the state of Paraná. Our aims were 1) to evaluate the spiders species composition and the community attributes (abundance, species richness and diversity) in the Parque Municipal das Araucárias over one-year sampling; and 2) evaluate to what extent the variation in monthly rainfall and mean temperature can affect these community attributes. We hypothesized that the variation in monthly rainfall and mean temperature and rainfall over the year, will influence the abundance and richness of spider species would be positively related to monthly rainfall and mean temperature.*”

**A.6.** Material and methods: Identify how many pitfall were installed in the site study. Which the spatial sampling range? If more of one pitfall, which the distance among they? (paragraph 3).

**Reply:** We improved our data sampling details, especially regarding the pitfall trap methodology: *“The third method (PT) was used to increase the number of spider records in the study area. It is an ideal method for wandering and tube spiders that move over the litter (Curtis 1980; Raub et al. 2014). There were four expeditions (July and October 2010, and January and May 2011), and 100 pitfall traps were used in each expedition. The traps were made with 500 ml plastic cups of 8 cm of opening diameter buried in the soil and keeped in the field during five days. Ethanol at 70% was used as preserving solution. All these methods are described in detail by Coddington et al. (1991) and Brescovit et al. (2004).*

**A.7** There is a great problem in statistical analysis, bellow I describe the topics: Not are maked Pearson correlation analysis for causality relationship between variables, and yes linear regression (paragraph 6)

**Reply:** Thank you. Your methodological concerns raised in your review were totally right. As you can see, we tested for the relationships with climatic data and communities attributes using a multiple regression based on linear mixed models: “To evaluate the relationships between climatic data (monthly rainfall and mean temperature) and spiders community attributes (abundance and species diversity), we performed linear mixed models including sampling method and transect as random effects (to account for the nestedness and the lack of independence among the sampling methods and transects among months). We used all subsets multiple regression analysis and selected the models that had lowest Akaike Information Criterion (AIC), considering the null model (only intercept). Models were considered to be equally supported if the difference in AIC was lower than two units (Burnham & Anderson 2002). When models were equally supported, we selected the most parsimonious model (with lowest number of predictors)…”.

**A.8** I think be important run multiple linear regression models with factors in double interactions.

**Reply:** Please check our previous reply.

**A.9** No there was none information to why to accomplish data transformation in the analysis. None justification to why transformation in log abundance or square root in richness. Why not run generalized linear models for count data?

**Reply:** We explained this section better, indicating why we log10-transformed spiders abundance. As richness showed a normal distribution, we used its absolute values: “Spiders’ abundance data were log10-transformed prior to analysis, to meet the assumptions of normality, homoscedasticity, reduce the effect of outliers and to account for possible nonlinear relationships between variables.”

**A.10** Caution! Your analysis have to take into account that they were measures repeated in time (longitudinal data). This violates the assumption of sample independence. Analysis like Student’s t- test require that the data have sample independence. Not is your case.

**Reply:** Sorry for our methodological mistakes. As we explained above, we are now using linear mixed models including sampling method and transect as random effects (to account for the nestedness and the lack of independence among the sampling methods and transects among months).

**A.11** Explain better why collected abiotic data of monthly minimum and maximum temperatures and mean humidity. Why not average rainfall or average temperature? As described on the climatic characteristics of the area being “humid and super humid climate” (paragraph 1), I would not expect this variable to be a limiting factor for spider fauna variation.

**Reply:** We removed monthly minimum and maximum temperatures, and mean humidity (as you suggested), and included monthly mean temperature and monthly rainfall. We agree that they are better predictors of spiders abundance and richness. Please check our Figure 2 and Results section.

**A.12** For improve the ecological aspects of the work, I suggest run multivariate analysis to species composition either between collect techniques or between predictors variables climatic - E.g. permanova, anosim. I think will give a up-grade in the manuscript.

**Reply:** Thank you for pointing this out. We included a PERMANOVA analysis followed by SIMPER to compare species composition among climatic data. Indeed these new results improved the ecological aspects of our manuscript: “*Differences in species composition among monthly mean temperature and rainfall were tested using a PERMANOVA (Anderson 2001) and based on an abundance species matrix comprising all adult individuals (999 permutations and Bray-Curtis as a distance measure). The null hypothesis is that there is no difference in species composition among different climatic conditions. To evaluate which species mostly contributed to differences in species composition between the warm and cold periods, we performed a similarity percentages test (SIMPER, based on Bray-Curtis distances matrix and 999 permutations). This analysis compared the relative abundance of each species between the six hottest and coldest months.”*

**A.13** Results: Many descriptive information and not is clear which the aims this manuscript (paragraph 2, 3 and 4). I think that all this paragraphs previously mentioned can be described in one paragraph. I suggest to focus in the results ecologicals of cause-effect, as richness and abundance in function of temperature, humidity or rainfall, or analysis of species composition, among other.

**Reply:** Thank you for your great inputs in our manuscript. As you can see, we improved our results and discussion focusing in the ecological theories and implications of our results, reducing the exhaustive descriptive parts.

**A.14** Graph 2 and graph 3-4 have the same information. I suggest to focus in results of graph 3 and 4 instead of graph 2. The variables (max and min temperature) are correlated? If yes you do not need both.

**Reply:** We made new figures and we are now using mean temperature rather than max and min temperatures (as they were both correlated).

**A.15** Discussion: In general, discussion could be better elaborate and more consistent. In my opinion there are a lot of results but few connection and results between them. I miss an interpretation in a broader context that considers the factors that alter the diversity temporal of spiders. The part more interesting of the manuscript is little addressed. This section have more information taxonomic-descriptive and less ecological. I suggest to focus more in the patterns found and less in what species were recorded. The discussion is more comparative the others papers and little effective on ecological questions.

**Reply:** As explained above, we restructured all the discussion, focusing in the ecological theories and implications of our results and reducing the exhaustive descriptive parts.

**A.16** Spiders are important predators of invertebrate, herbivore control in the tree or shrubs, competitors of resource and none of this was approached in discussion. The last paragraph not finalize with a conclusion. I felt lack of message for home.

**Reply:** We again thank you for your detailed review. Your suggestions greatly improved our manuscript. We included a final paragraph, including yours suggestion about spiders importance: “Recent studies show that natural communities are shifting in species composition due to climatic changes (Raymundo *et al*. 2018). Our study indicates that the abundance and diversity of spiders’ communities is related to variations in temperature and precipitation. Spiders play a significant ecological role in ecosystems as they are part of the diet of many birds and lizards species (Spiller & Schoener 1998, Gunnarsson 2007), and are important predators of arthropods, controlling the population of herbivorous insects, and consequently reducing plants damage (Polis & Strong 1996). Future studies at large scales on biogeography and dynamics of spiders communities and their relationships with climatic variation are needed, and could provide more insights into these communities responses and resilience to global change.”

**A.17** Minor issues: I suggest that the authors hire a copyeditor. Title, please, improve.

**Reply:** We changed the title to “Climatic conditions drive the abundance and diversity of spiders community in an Atlantic Forest fragment”.

**A.18** o Determine better which classification climatic of region. In a moment is said that region no possess dry season and you classify in hot and rainy & cold and dry. Caution! (paragraph 1 and 2)

**Reply:** We apologize for this mistake. We now highlighted that our study area experience a temperate climate, with weak or absent seasonality in rainfall but a marked variation in monthly mean temperature: “The region experiences a warm temperate climate, with warm summers and no dry season (Cfb, sensu Köppen-Geiger climatic classification). Mean annual rainfall is 1770 mm, and well distributed over the year (Alvares et al. 2014). Monthly mean temperature during the summer and winter are 19.1°C and 14.4 °C, respectively (Alvares et al. 2014).”

**A.19** Standardize institutional names (paragraph 4)

**Reply:** Done.

**A.20** I suggest use alpha symbol “α”for indicate subject of type I error, since that exist alpha diversity term (paragraph 6)

**Reply:** Done.

**A.21** I not think that be relevant notify the software used to create plot (paragraph 6)

**Reply:** Removed.

**A.22**  Inform which months was realized the samples pitfalls methods.

**Reply:** We improved the pitfall trap methodology as you can see in a previous comment and indicated in which months this methodology was used. “There were four expeditions (July and October 2010, and January and May 2011), and 100 pitfall traps were used in each expedition”.

------------------------

REVIEWERS COMMENTS TO AUTHOR

Reviewer C:

**D.1** This word must be removed because there is no seasonality in your article. You have only one year of sample process, thereoe it´s doesn´t constitute a seasonal pattern. You have annual variation.

**Reply:** We are thankful for our review. You pointed many important concerns that are now correctly addressed. We agree with you and removed this word from Keywords and through the manuscript, indication temperature and rainfall variation instead of seasonality.

**D.2** I think all the text in introduction must be changed. The authors must analyze carefully these part. The title doesn´t agree with introduction. No one paper about how abiotic factor affects spiders communities were preented here. These introduction is well indicated to paper focused on spider survey from Auraucária áreas.

**Reply:** Your suggestion was quite valuable. As you can check, we wrote a new introduction, removing some paragraphs that were not related to our aims, and explicating the relationships between climatic data and spider communities attributes.

**D.3** don´t agree with this statement! This not refrlec the actual reality

**Reply:** This sentence was removed.

**D.4** This number must be changed for more actual

**Reply:** This sentence was removed.

**D.5** You should include a paragraph about biotic factors / climatic factors from others brazilians biomes or continentes, like Europe...

**Reply:** As we mentioned above, our introduction was completely restructured, following yours and other reviewer suggestions: For instance: “Although some studies have evaluated the relationships between climatic conditions and populations of spiders (Messas et al. 2017; Romero & Vasconcellos-Neto 2003; Villanueva-Bonilha et al. 2018), we still poorly understand how these relationships occur at the community level. The influence of monthly precipitation and mean temperature in spiders communities may have multiple simultaneous effects. For instance, they can influence habitat structure and the selection of habitats by spiders (Uetz, 1991), affecting the availability of prey and the establishment of different arthropods populations (Wise 1993; Nyffeler 1999; Arango et al., 2000). Moreover, climatic variables can directly influence population dynamics and the reproductive and foraging periods of spiders (Romero & Vasconcellos-Neto 2003, Villanueva-Bonilha & Vasconcellos Neto 2016).”

**D.6** For seasonal pattern, at least a second year of sample process is necessary to compare seasonal patterns

**Reply:** We are not saying we have a season pattern anymore.

**D.7** It´s extremelly necessary the authors cite one reference which describe those methods below.

**Reply:** We included the studies describing the methods and that used them. As you can check, we improved this section with your suggestions, providing a detailed description of our sampling methodology: *“To improve our sampling effort (as different spiders species occupy different habitats, e.g., arboreal, shrubby, soil), we used three different sampling methods, as suggested by Coddington et al. (1991): beating tray (BT), nocturnal manual collection (NMC) and pitfall traps (PT). BT allows the access of tall herbs, small and medium-sized shrubs, small trees and large tree branches, and was used to sample mainly arboreal (Dias et al. 2006; Podgaiski et al. 2007). NMC was carried out using headlamps and was used to access animals active at night, including those that walk over soil or vegetation up to 2 m high (Brescovit et al. 2004; Dias et al. 2006). Both BT and NMC methods were conducted along three transects of 30 m (length) x 10 m (width), placed at least 200 m far from each other, and each transect represented a 50-minute period of search. Hence, our sampling effort for those methods resulted 72 sample units = 2 methods (BT and NMC) × 3 transects × 12 months. The third method (PT) was used to increase the number of spider records in the study area. It is an ideal method for wandering and tube spiders that move over the litter (Curtis 1980; Raub et al. 2014). There were four expeditions (July and October 2010, and January and May 2011), and 100 pitfall traps were used in each expedition. The traps were made with 500 ml plastic cups of 8 cm of opening diameter buried in the soil and kept in the field during five days. Ethanol at 70% was used as preserving solution. All these methods are described in detail by Coddington et al. (1991) and Brescovit et al. (2004).”*

**D.8** How was the minimum distance of these transect between each other?

**Reply:** As commented previously: “*Both BT and NMC methods were conducted along three transects of 30 m (length) x 10 m (width), placed at least 200 m far from each other, and each transect represented a 50-minute period of search. Hence, our sampling effort for those methods resulted 72 sample units = 2 methods (BT and NMC) × 3 transects × 12 months.”*

**D.9** The same question ...

**Reply:** Please check our previous comment.

**D.10** Many important information of pitfall trap are necessary and must be cited here, like: size of pitfall trap, operation time, what kind of conservant solution was used, Althought spiders from pitfall trap wasn´t included on statistical analysis, I believe they were included on species list....

**Reply:** You are right. We provided a detailed description on pitfall traps as you can check: “*The third method (PT) was used to increase the number of spider records in the study area. It is an ideal method for wandering and tube spiders that move over the litter (Curtis 1980; Raub et al. 2014). There were four expeditions (July and October 2010, and January and May 2011), and 100 pitfall traps were used in each expedition. The traps were made with 500 ml plastic cups of 8 cm of opening diameter buried in the soil and kept in the field during five days. Ethanol at 70% was used as preserving solution. All these methods are described in detail by Coddington et al. (1991) and Brescovit et al. (2004).”*

**D.11** Why Instituo Butatan gave an authorization for you? Normally, SISBIO provides research authorization.

**Reply:** You are right, sorry for this mistake. We removed this sentence.

**D.12** It´s necessary provide the tombe number of species collected

**Reply:** Unfortunately we do not have the tombe numer of species collected. However we now explain that “*the material yielded by this study was deposited in the collection of Arachnida of the Instituto Butantan (IBSP, curator: A.D. Brescovit*)”.

**D.13** Who was the taxonomist who identified ypur species?

**Reply:** “*Spiders were identified by Antonio Brescovit (third author of this manuscript) to species level when possible, and only adult specimens were considered. Immature individuals were identified to families level. The material yielded by this study was deposited in the collection of Arachnida of the Instituto Butantan (IBSP, curator: A.D. Brescovit)*”

**D.14** The reference of Estimates must be included.

**Reply:** We performed all statistical analyses again using the R software and different packages. *“All statistical analyses were performed in R 3.1.2 (R Core Team, 2017). Linear mixed models were performed using the “lme4” package (Bates et al. 2011) and all subsets regression analyses using the “MuMIn” package (Barton, 2009). Chao1 estimator, PERMANOVA and SIMPER analyses were performed using the “vegan” package (Oksanen et al. 2014).”*

**D.15** Which version of Estimates was used? Did you used which setup? Did you use replacement? How many times did you randomized your data?

**Reply:** Please check our previous comment. We now explain that we used 100 permutations to estimate richness: “*Chao1 estimator was performed using 100 permutations, and take into account the proportion of rare and abundant species, and are least-biased and efficient methods to estimate the total richness from a sampling area (Scharff et al. 2003)*.”

**D.16** Which kind of T student? A paired T Student?

**Reply:** You are right that our samples are not independent and a nestedness method should be included. We are now using linear mixed models including sampling method and transect as random effects (to account for the nestedness and the lack of independence among the sampling methods and transects among months): “*To evaluate the relationships between climatic data (monthly rainfall and mean temperature) and spiders community attributes (abundance and species diversity), we performed linear mixed models including sampling method and transect as random effects (to account for the nestedness and the lack of independence among the sampling methods and transects among months). We used all subsets multiple regression analysis and selected the models that had lowest Akaike Information Criterion (AIC), considering the null model (only intercept). Models were considered to be equally supported if the difference in AIC was lower than two units (Burnham & Anderson 2002). When models were equally supported, we selected the most parsimonious model (with lowest number of predictors)…”.*

**D.17** Reference?

**Reply:** We removed this sentence.

**D.18** Please, cite the reference of “JMP”.

**Reply:** As we explained above, all analyses were performed using R software now.

**D.19** Not only for abundance, but also for species richness,, the authors should uses a GLM´s for each biotic factor and test by a null modell if they are real significant. The authors also compare the equations from maximum and minimum between a glm and see if they really differs.

**Reply:** Thank you for your suggestion. We made new analyses as you suggested: “*To evaluate the relationships between climatic data (monthly rainfall and mean temperature) and spiders community attributes (abundance and species diversity), we performed linear mixed models including sampling method and transect as random effects (to account for the nestedness and the lack of independence among the sampling methods and transects among months). We used all subsets multiple regression analysis and selected the models that had lowest Akaike Information Criterion (AIC), considering the null model (only intercept). Models were considered to be equally supported if the difference in AIC was lower than two units (Burnham & Anderson 2002). When models were equally supported, we selected the most parsimonious model (with lowest number of predictors)…”.*

**D.20** I didn´t see this in your text. Please, provide a bar graphic with two axis, one for temperature, rainfall and ir humidity

**Reply:** Thank you. We now provided Figure 1 with: “Monthly rainfall and mean temperature over this study sampling (July 2010 and June 2011) obtained from the meteorological station SIMEPAR (Sistema Meteorológico do Paraná). Bars indicate monthly rainfall and line indicate monthly mean temperature.”

**D.21** Pay attention on scientific names! They must be wrtitten in italiccs

**Reply:** Sorry for our mistake. We checked all scientific names throughout the manuscript.