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Dear Dr Gwilym Davies,
Thank you very much for the time and effort you devoted to editing our manuscript.

We appreciated the comments and suggestions you and the Reviewers provided and we have now completed the revision of the original manuscript. We feel that the revisions have resulted in a stronger presentation of our work and we hope you agree!

Almost without exception all of the suggestions made have been accepted and suggested changes to text, and figures have been made. We have done our best to improve the quality and shorten the number of figures, To do this we have combined Fig. 4 with Fig. 5 (now a new Fig. 4), changed Fig. 8 into a table (Table S2) and adding it along with Fig 10 (now Fig. S1) to the supplemental material.

Below, we provide a list of the changes made to each of the points made by the Reviewers. For your convenience, our action/response to each point is reported in blue text.

We feel that the revision process has greatly improved the clarity and readability of the ms and we sincerely hope that this version will be deemed worth of publication in PeerJ. However, we will be happy to undertake further changes according to any further suggestions you may like have to improve our paper.

Thank you very much for your time and consideration.

Best Regards

Valentina Cusceddu

ValentinaCusceddu (Corresponding author)

Editor's comments

This paper was enjoyable to read and reports a very thorough study of the process structuring community assembly in a sand dune community. Frequently offered in textbooks a case study of the process of succession the authors are right to state there have been few experimental/manipulative studies of this kind. This is an important paper in that regard

The paper describes a fairly large number of related experiments that are gradually introduced through the methods section. I would like to see clear objectives for each of these provided in the Introduction. Given the complex nature of the paper, with inter-related hypotheses being tested, it would be clearest if a numbered, or bullet-point list of objectives were provided - one for each experiment.

We have included a table (Table 1) that clarifies the objectives of our experiment.

The reviewers suggest that there is possibly too much in this paper and I agree that there definitely some sections that seem more relevant than others to the story they want to tell. Looking at the discussion section I think you should be able to tell where cuts can be made - doing so will make the overall message clearer whilst only sacrificing a number of "add-n" experiments.

Actually, each experiment listed in the ms has a role in the whole story message. With the new table (Table 1) cited at the end of the introduction and some displacements made in the text, we hope that it is now easier to follow the sequence of the experiments according to the three initial hypotheses.

Many of the Methods paragraphs start "To examine" or "To test" which gets a little wearying, can the language be made a little less repetitive?

Yes, we agree, the language has been reworded.

As the reviewers suggest there is a clear need to improve the quality of the figures and it's questionable whether they're all needed. I did like the Figure 12 though and thought it gave a nice summary of the findings.

The figure quality has been improved, according to the reviewers suggestions, moreover Fig. 8 has been transformed in a table (Table S2) and with Fig. 10 (now Fig. S1) have been added to the supplemental material. We concur about Fig. 12, our objective was exactly to give a simple visual summary of the findings. We're glad that you like this figure as well.

Some details from the annotated manuscript PDF that would need more explanations:

Line 140: we added a reference to give some quantitative data.

Line 144: Actually, the species build communities adapted to stress, for this reason the sentence has been reworded.

Line 154: Zonation was quantified on the basis of composition. The beginning of the paragraph has been modified to better explain our approach.

Line 155: The word 'transects' is incorrect, it wasn't a proper transect, we revised this section. At the same time we would highlight that there could not be pseudo-replication about these data, first because the plots were sufficiently far from each other to not be influenced by the previous and/or the following plot and, second, because we only made the Shannon index on these data and not a more specific statistical analysis.

Line 174: In the Plant elevation experiment *Armeria* was the only species with an inconsistent effect across zones (this detail has been added in the ms).

Line 191: The initial hypothesis for this experiment was that live and dead plants have a different capacity of trapping sand and we wanted to have a measure of this difference. For this reason dead above ground vegetation was left to simulate natural death, to evaluate the consequences of the lack of activity in terms of erosion. We now clearly state this in the text.

Line 208: By 'pooled' we meant took into account and, in a second time, averaged. The sentence has been rephrased.

Line 226: Species assigned for removal were pulled (eradicated), manually when possible.

Line 379: Sediment variation means sediment level variation.

Line 392: The two max temperatures reported for each zone are for removal and control, respectively, now, this has been explicitly stated.

Line 396: 5° C higher! Error corrected.

Reviewer Comments

Reviewer 1 (Rob Marrs)

Basic reporting

The submission appears to adhere to all PeerJ policies.

The article is written in English using clear and unambiguous text and must conform to professional standards of courtesy and expression. But it could be improved.

The article includes sufficient introduction and background to demonstrate how the work fits into the broader field of knowledge. Relevant prior literature should be appropriately referenced.

I don't know the templates but this looks pretty good to me.

Figures are relevant to the content of the article, of sufficient resolution, and appropriately described and labeled. But could be improved

The submission is 'self-contained,' represent an appropriate 'unit of publication', and includes all results relevant to the hypothesis. Coherent bodies of work should not be inappropriately subdivided merely to increase publication count.

All appropriate raw data has been made available in accordance with our Data Sharing policy.

Experimental design

The submission describes original primary research within the Scope of the journal.

The submission defines research questions, they are relevant and meaningful. The knowledge gap being investigated identified, and statements are made as to how the study contributes to filling that gap.

The investigation has been conducted rigorously and to a high technical standard.

Methods should be described with sufficient information to be reproducible by another investigator.

The research is conducted in conformity with the prevailing ethical standards in the field.

Validity of the findings

The paper is a weighty one and I suspect it could be pruned a little and this would probably make it more effective. But I like it overall. Good paper.

On a grammar note I am a total pedant and like lots of hyphens (shorten your word count!) and I don't like split infinitives - sorry I know I am probably the old one left!

I have made some suggestions to the text to help improve clarity. See attached sheet (hope you can read my writing).

Ok, we have followed these suggestions.

I have some issues with the reproduction of the anovas, not because I think they are wrong but they are not clear to me from the text.

We have made several corrections in the Methods section, some of which is information about the analyses. It should now be easier for another investigator to reproduce our experiments.

You said you were going to refer to plant species by genus - but then use ice-plant- I would stick to your original suggestion. *Carpobrotus*

Ok, done.

L. 71 sentence isn't clear to me

The sentence has been restated.

L.74-83 Long sentence - suggest rewording

Reworded.

L108 what is biogenic?

Right, this is incorrect to refer this word to the species, it would be better to refer it to the habitat, we deleted it.

L130 Leave this to the discussion.

Moved to the discussion.

L211 I don't follow your sentence - what data are being analysed in this three way anova i.e. what is y in $y \sim a * b * c$

The sentence has been rephrased. We analyzed temperature data (response variable), considering the three factors: zone (fore vs middle vs back) , range (Min vs Max), and treatment (removal vs control); $y(\text{temperature}) \sim a(\text{zone}) * b(\text{range}) * c(\text{treatment})$.

L367-369 this is or should be in methods

Moved to the methods.

L445-455 You start analysing this as a oneway (?) but then move to a 2-way Surely you start with the two way and if the interaction is significant this is the contrasts of interest. The one-way responses are irrelevant - or have I misunderstood. If so reword for clarity.

Yes the one-way responses are irrelevant and confounding, we reworded and deleted the one-way results because the two-way outcomes were enough to explain the effect of our experiment.

Indeed it might be one way to shorten the manuscript is to put in a table of anova tests for each set of measurements analysed. Then you could just state that Anova was used to test for treatment effects (Table 2). It could even be in a supplementary appendix. I really did get confused with the way you have written it. I am not suggesting you have done it wrong, just find it hard to follow.

You could also in the Table identify fixed and orthogonal effects. This would reduce wordage in the text and help improve flow.

We followed this suggestion for a couple of experiments but not for all. We are afraid that it would be annoying for the reader to have to go frequently from the text to an appendix table, to see the statistical results of each experiment, especially if there are significant results. For this reason we added a table in the appendix only for the Seed distribution experiment (Table S1) and for the Physical stress alleviation experiment (Table S3).

You also don't specify the package you used to do the analyses in the Methods.

The package we used to do the analyses has been specified in the Methods (GMAV-Underwood and Chapman 1998).

The graphs need to be improved.

Fig. 1-3 OK

Fig. 4, 5 could you not put them together on one figure. You discuss them together and it is irritating to move between them suggest you put the three panels on Fig 5 along the top of fig 4. Perhaps reduce the size of the symbols in Fig.5.

Ok, done.

Fig. 6-7 OK

Fig. 8 Might be better as a Table - Data are percent presumably refers to the numbers but this is unclear as the graphs themselves represent data.

Ok, we transformed the figure in a table (Table S2) that now has been added to the supplemental material.

Fig 9. Suggest you reduce the symbols to a much smaller size as they obscure the trends.

We preferred to reduce the number of the symbols instead of reducing their size, in this way the lines are more visible and the trends more clear, without losing definition.

Fig. 10 +/- SEs would be a good addition if possible

The addition of +/- SE is not possible because data are percentages.

Fig. 11 again I would reduce the size of the symbols as they make the lines look unclear Or just use the lines with perhaps one symbol at end of line. It is messy and will difficult to read in print.

Ok, we left just one symbol at end of line.

Fig. 12 This could be improved a lot to improve visual impact.

Actually, the figure is deliberately minimalist because our aim was to add a simple and linear sketch to represent the findings, for this reason we haven't make any change.

Comments for the author

Interesting paper, looks well done. comments above are to help improve the final draft. Minor corrections I don't want to see it again.

Annotated manuscript

The reviewer has provided feedback as [annotations on the manuscript PDF](#).

From the annotations on the manuscript PDF we would like to confirm that we used rebar to border our plots, it was a way to avoid vandalism and prevent loss of the replicates.

Reviewer 2 (Anonymous)

Basic reporting

- The language is clear and professional!
- Introduction and background is okay. However, see specific comments.
- Literature: I am not sure I fully understand the difference between Grime's old but relevant theory of stress, competition and ruderalism (CSR) and the stress hypothesis used here. Maybe the authors could point out important differences. Or argue why they don't use Grime's theory which seems perfect for dune systems.

In this ms we are testing hierarchical organization using the Stress Gradient Hypothesis (SGH) that is a broad plant and animal model that includes positive interactions. Grimes model is a plant descriptive model that doesn't include positive interactions. The SGH and hierarchical organization are both currently very topical questions that for ecology that transcend plant ecology. Actually, our ms would better fit to an experimental community ecology paper than a plant ecology one.

- Structure: I think the results and discussion part is somewhat mixed – so is the discussion and conclusion part (see specific comments).
- Figures: There are a lot of figures! Maybe some of them can go in appendix – or be transformed to tables. Or the whole paper should be rewritten to only focus on the initial hypotheses stated in the introduction – this would decrease the number of figures. See specific comments.

Experimental design

- Research question: Research questions are well defined in the introduction but a lot of add-ons are introduced later on (in the methods section). In general I think the paper could benefit from limiting the number of experiments and focusing on the most relevant ones.

In this paper there are a lot of experiments, we agree, but limiting their number may reduce the strength of our findings, because every experiment has a specific role in the whole story. We made a table (Table 1) to help the reader following the sequence of the tasks and their role connected to the initial hypotheses.

Validity of the findings

- Conclusion: consider a more concise conclusion (see specific comments).

Comments for the author

Specific comments

Introduction

Line 54-56: Sand drift and sand burial are equally harsh (if not harsher) to dune plants (as salty conditions) – I think it should be mentioned here also as it highly affect the species composition along the dune-inland gradient!

Considering this comment we changed the word ‘alophytic’ with ‘xerophytic’.

Line 73: I am not sure I like the ‘ecosystem service’ angle here. Is providing habitat for (threatened) species an ecosystem service? I think not – if ecosystem service is defined as something humans profit on (like pollination of crops)? Species diversity has its own right and it is not necessary to ‘justify’ by lumping it into ‘ecosystem services’.

‘Ecosystem service’ has been changed with the more appropriate ‘socio-economic benefits’.

Line 74: I think it is a bit of a statement to say that most research on sand dune communities is outdated and descriptive! A lot of recent work is quite the opposite... maybe rephrase to ‘historically, most research...’ or specify that research within your field (‘foundation species’, stress hypothesis) is missing - or something similar (for literature examples see studies by e.g. S.

Provoost, M.A. Maun, A.K. Brunbjerg, E. Forey,).

Rephrased as suggested adding ‘Historically...’.

Line 118-131: I am not sure I can follow the reasoning behind the term ‘elevation gradient’ and the changes of important processes along it. To me, elevation can be misunderstood – most often you will see the gradient in dunes described as a sea-inland gradient along which stress and disturbance decrease.

Also, if using the sea-inland gradient stress does not necessarily decrease inland as many dunes (at least in Europe) ‘end’ in dwarf shrub dominated dune heaths – these are very stressful environments because of the low pH! Maybe you need a more precise definition of stress versus disturbance here? I would say you work along a disturbance gradient – not a stress gradient (sensu Grime)!

Elevation is a much better metric for plant communities on dunes because distance is a function of wave energy and not necessarily linearly correlated with stresses. There are exceptions to all gradients. Our germination and survival results on seed transplants show demonstrate that our interpretation of the physical stress landscape is largely correct.

Also, our natural seedling experiment reveal that our elevational stress gradient accurately reflects plant responses.

Line 125: maybe you could point out that ‘foundation species’ may actually just be the sand-binders found mainly in fore dunes?

Actually, we hypothesize that the role of the foundation species is more than the simply sand-binding so we found more appropriate to describe it as stabilizing the system. Moreover, with the definition ‘seaward border of the dune’ we mean not only the fore dune but even the front of the fore dune.

Materials and methods

Line 151: should Figure 2 be called figure 1 instead – as this is the first figure you refer to in the manuscript?

Yes, done.

Line 160: how can you ‘estimate plant species’? Do you mean plant species frequency?

We mean plant species cover, now it should be clearer.

Line 161: replace sampled/zone with sampled in each zone or sampled per zone.

Ok, done.

Line 174: this is the first time you mention *Armeria* – please give the full name!

Ok.

Line 164-174: this is kind of an add-on to the original hypotheses you wanted to test (and stated at the end of the introduction) – is this important? If it is, I think it should be included in the study questions/hypotheses in the introduction – otherwise it is just a confusing add-on.

Maybe in the early version of the ms the importance of some of the experiments has not clearly emerge, but we sincerely hope that improvements in the ms have made clear the aim of each experiment.

Line 178: replace 3 with ‘three’

Line 185: same as above

Ok, both done

Line 201-213: again, an add-on to the original hypotheses. I suggest, you at least state your hypothesis related to the observed phenomenon here. What is the point of measuring temperature? What do you expect to find?

We have added a table (Table 1) that helps to relate the role of each experiment to the initial hypotheses. We presume the answers to these questions can be found in the text. Line 205: ‘...we began monitoring temperature after noting apparent summer heat death of some high middle-dune plants during the first year of this experiment... .. This allowed us to quantify plant heat exposure during the summer, and quantify differences between control and removal treatments...’

Line 218-220: the species pairs you choose are presumably the most dominant species – right?

Maybe you can give an estimate on how dominant they are as a justification?

We added a parenthesis to recall the plant zonation results as reference about the dominant species in this system.

Line 230: state why you transform the *Carpobrotus* data.

Reason for the transformation added.

Line 235-249: again, an add-on... see comment to line 201-213. I only see a reason to include these add-ons if you think they may affect the results of the original hypotheses.

To state our findings we need all the experiments that are itemized in the ms. Each one has its "little role" in the results and contributes to their final interpretation, being related to one of the three hypotheses and giving more emphasis to the analysis that has been explained in the discussion.

Line 261: transformed how?

$\ln(X + 1)$, inserted in the text.

Line 263-326: How are these experiments/data related to the three original hypotheses/study questions at the end of the introduction? Please clarify in the text (either here (e.g. by adding a more specific section header) or in the introduction/study questions).

At the end of the introduction we added a Table with the objectives and the corresponding tasks performed to examine the hypotheses.

Line 289: do you mean seedling growth?

Yes, exactly, we have corrected.

Line 293: replace 3 with ‘three’

Line 302: same as above

Ok, both done.

Results

Line 413-343: Results and discussion seem a bit mixed here: e.g you conclude on what causes the changes in species cover (‘competitively depressing’, ‘facilitating effect on’)... just keep it to the change in cover here – and the state the possible causes in the discussion.

Following this suggestion, we completely rephrased.

Line 440-443: This belongs in the discussion.

Line 455-457: This belongs in the discussion

Ok, both moved to the appropriate discussion section.

Line 511: replace different by differ

Ok, done.

Discussion + conclusion: To me, much of what is written in the conclusion part belongs in the discussion. Keep the conclusion part concise and punchline like. Conclusion could maybe be line 656-684 or even only line 673-684.

Conclusion now is line 656-684, following this suggestion.

Line 609: Replace 3 with three

Ok, done.

Figures: I would like to see a figure showing a map of Sardinia + Italy and the location of your plot. A map of Sardinia + Italy and the location of our plot has been added to Fig. 1 (ex Fig. 2).

12 figures is a lot! Maybe some of them could go in appendix or be transformed to tables?

We agree with this statement and now we have 9 Figures and 1 Table plus 1 Figure and 3 Tables in the appendix.

Fig 1: Do we need the full name of the plants and not just the genus name here?

We think that adding the full name in this figure could make it a bit messy, even because some of the full names are quite long.

Fig 3: Maybe add to the figure text how many years the experiment was running.

Ok, done.

Fig 4: Do we need the full name of the plants and not just the genus name here (in the figure text)?

In this case there is no problem to add the full name of the plants in the figure text.