Peer Community In Ecology

# Importance of Scale Considerations in Understanding Seagrass Dynamics

***Antoine Vernay*** *based on peer reviews by* ***Gudrun Bornette*** *and 2 anonymous reviewers*

Élise Lacoste, Aurélien Boyé, Aline Blanchet-Aurigny, Nicolas Desroy, Isabelle Auby, Touria Bajjouk, Constance Bourdier, Nicolas Cimiterra, Céline Cordier, Amélia Curd, Lauriane Derrien, Élodie Foucault, Jean-Dominique Gaffet, Florian Ganthy, Loic Rigouin, Claire Rollet, Laura Soissons, Aurélien Tancray, Vincent Ouisse (2024) Regional and local variability in the morphometric traits of two emblematic seagrass species (*Zostera marina* and *Zostera noltei*) along the French coast. Zenodo, ver. 3, peer-reviewed and recommended by Peer Community in Ecology. https://doi.org/10.5281/zenodo.10427767

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Seagrasses, particularly Zostera species, have been the subject of numerous studies due to their widespread distribution across the globe (Short et al., 2007), yet they have been in decline for several years as a result of global environmental changes (Touchette, 2007). While case studies and regional studies have been conducted, there remains a lack of information on how to scale these findings, particularly because of the heterogeneous nature of these habitats.

In their study, Lacoste et al. examine the ecosystem trajectories of two Zostera species along a regional gradient spanning sites in the English Channel, the Atlantic Ocean, and the Mediterranean Sea. Their research is based on a recently published database, which offers valuable insights for comparing with other studies and serves as a resource for addressing future questions (Lacoste et al., 2024). This underscores the need for a global database to facilitate the integration of functional responses across studies, thus advancing our understanding of Zostera ecology on a larger scale. The multi-trait approach employed in their study provides a comprehensive view of population dynamics over a 1.5-year period, covering different seasons.

Such studies highlight the complex responses of Zostera populations when considering environmental, seasonal, and geographical heterogeneity. Understanding these dynamics raises important questions about modeling, particularly in relation to the development of a more global database as previously mentioned.

However, the review process has pointed out that the environmental data should be further refined to more rigorously support the presented results. Some statistical analyses could also benefit from improvements to

ensure clearer and more explicit conclusions. These concerns are related to the challenges of sampling, the time required for such efforts, and the need to account for spatiotemporal variability. This study could serve as a foundational step for advancing our understanding of Zostera population dynamics on a global scale. In my opinion, despite the large ongoing scientific efforts, upscaling remains one of the major challenges for functional ecologists (Wood et al., 2024), particularly when plant habitats exhibit the kind of heterogeneity seen in Zostera, as demonstrated by Lacoste et al. in their work.

***References:***


Élise Lacoste, Aurélien Boyé, Aline Blanchet-Aurigny, Nicolas Desroy, Isabelle Auby, Touria Bajjouk, Constance Bourdier, Nicolas Cimiterra, Céline Cordier, Amélia Curd, Lauriane Derrien, Élodie Foucault, Jean-Dominique Gaffet, Florian Ganthy, Loic Rigouin, Claire Rollet, Laura Soissons, Aurélien Tancray, Vincent Ouisse (2024) Regional and local variability in the morphometric traits of two emblematic seagrass species (Zostera marina and Zostera noltei) along the French coast. Zenodo, ver.3 peer-reviewed and recommended by PCI Ecology https://doi.org/10.5281/zenodo.10427767

Lacoste, E., Ouisse, V., Nicolas, D., Allano, L., Auby, I., Bajjouk, T., Bourdier, C., Caisey, X., de Casamajor, M.-N., Cimiterra, N., Cordier, C., Curd, A., Derrien, L., Droual, G., Dubois, F. S., Foucault, E., Foveau, A., Gaffet, J.-D., Ganthy, F., … Blanchet-Aurigny, A. (2024). A dataset of Zostera marina and Zostera noltei structure and functioning in four sites along the French coast over a period of 18 months. https://doi.org/10.5281/zenodo.14174128

Short, F., Carruthers, T., Dennison, W., & Waycott, M. (2007). Global seagrass distribution and diversity□: A bioregional model. Journal of Experimental Marine Biology and Ecology, 350(1), 3□20. https://doi.org/10.1016/j.jembe.2007.06.012

Touchette, B. W. (2007). The biology and ecology of seagrasses. Journal of Experimental Marine Biology and Ecology, 350(1), 1□2. https://doi.org/10.1016/j.jembe.2007.06.013

Wood, G. V., Filbee-Dexter, K., Coleman, M. A., Valckenaere, J., Aguirre, J. D., Bentley, P. M., Carnell, P., Dawkins, P. D., Dykman, L. N., Earp, H. S., Ennis, L. B., Francis, P., Franco, J. N., Hayford, H., Lamb, J. B., Ling, S. D., Layton, C., Lis, E., Masters, B., … Wernberg, T. (2024). Upscaling marine forest restoration□: Challenges, solutions and recommendations from the Green Gravel Action Group. Frontiers in Marine Science, 11. https://doi.org/10.3389/fmars.2024.1364263


# Reviews

## Evaluation round #2


DOI or URL of the preprint: https://doi.org/10.5281/zenodo.13972244
Version of the preprint: 2


### Authors' reply, 03 January 2025

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### Decision by Antoine Vernay, posted 29 November 2024, validated 02 December 2024

Dear Elise et al.,

Reviewers have read your revised version. They acknowledge that you've made some substantial changes that improve the manuscript. Both agree that it can be acceptable for publication. However, the second reviewer and I underlined that some comments remained unanswered, and Figure 3, at minimum, has to be improved to be completely acceptable. Despite their remaining concerns about some conclusions, we may consider publishing it afterward.

Best regards,

Antoine VERNAY

### Reviewed by Gudrun Bornette, 31 October 2024

the authors have corrected the manuscript in line with the referees' comments, and the responses seem to me to be satisfactory. I propose to accept the manuscript.

### Reviewed by anonymous reviewer 2, 28 November 2024

The manuscript (MS) has improved since the last version. The authors have addressed most questions and suggestions but ignored some without providing any rationale for the issues raised.

I consider the MS to be based on an adequate biological database, well-written, and focused on a very interesting and innovative objective, examining ecosystem trajectories of two of the four European seagrass species. However, in my opinion, the environmental data is insufficient to explain the biological patterns and the authors fail to guide the reader to make the findings evident through the presented results. Nevertheless, it think that the MS is acceptable for publication.

## Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.5281/zenodo.10427768

Version of the preprint: 1

### Authors' reply, 22 October 2024

Dear recommender,

I would like to apologise for the delay in my reply.

In the attached documents you will find our responses to the reviewers as well as the corrected document. We hope that the corrections have helped to improve the document based on the reviewers' suggestions.

Best,

Elise

**Download author's reply**

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### Decision by Antoine Vernay, posted 07 June 2024, validated 07 June 2024

**Revisions needed before publication**

Dear authors,

First of all, I would like to apologize for the delay but it was very diificult to find two reviewers whos accept to review this manuscript. The two who accepted needed extra time to complete their review but now it is done. thanks for your patience.

Reviewers and I have found your paper very interesting but it could be improve before publications. Reviewers have proposed somes corrections and I think they are relevant. Please try to improve your manuscript by considering reviewers comment and resubmit your manuscript and your replies.

I hope you will accept to modify your work.

Best regards,

A. Vernay

## Reviewed by anonymous reviewer 1, 06 June 2024

The publication is a first approach to the seasonal population dynamics of two species of eelgrass in habitats with contrasting population health and environmental characteristics. The subject is well covered, although several points need to be answered or improved in the manuscript. The dataset is indeed quite large, but the analysis could perhaps have been more statistically sophisticated to better identify the major effects and contrasts between species. The lack of an approach to the hydraulic component is somewhat frustrating.

Introduction

line 61: delete ”availability”

line 61-62: the authros assert that the species is annual, but speak about winter survival as a plant with a single leaf. Is it really an annual plant or a plant with a winter dormancy ? (summergreen ? ). If yeas, it would be better not to speak about annual plant. What is the determinant of winter survival ? temperature, absence of freezing ?

methods :

one may have expected that the chloA content (for assessing the part of turbidity due tu phytoplankton abundance, and so assess the eutrophication pressure more accurately than nutrient content, when nutrients are in the vegetation) and water depth were surveyed (measured with a datalogger), for understanding how far submersion-emersion rythm and turbidity rule populations (cf introduction)?This would also make it possible to measure the behaviour of the two Z marina populations, and to situate them in relation to the trajectories of the other species.

results

lines 227-228: I ask myself what is the specificity of this paper compared to the one quoted ?

line 273 : the multivariate analysis method used does not seem to project the two species into the same statistical reference framework, which means that it is not possible to compare the amplitude of the statistical trajectories between species? For example, centring the dynamics data by species makes it possible to see how the two species vary within the same reference framework, and to compare the trajectories of their populations.

Figure 4 is rather difficult to understand, and would benefit from a more explicit description in the legend.

Discussion

line 394-395: Hydraulic stress seems to be a key factor controlling the traits and population dynamics of these species, but it has not been quantified at all. Would an indirect quantification, such as that provided by the granularity of the sediment, not have been possible, in the absence of direct, complex measurements in a partially inaccessible and turbulent environment

The plants themselves modify the current facies, and it is probable that we can have tipping effects beyond a given stem density threshold. The granulometry of the sediment at the foot of the stems is surely very informative on this point. In addition, sedimentation caused by plants can be harmful to plants in eutrophic conditions, increasing the anoxic phases of the sediment. In this context, turbulence is probably favourable to the oxidation of sediments by keeping them coarser;

## Reviewed by anonymous reviewer 2, 21 May 2024

This is an original piece of work with a refreshing methodology to deepen the understanding of seagrass dynamics. However, there are some issues that I consider important that the authors need to address before this manuscript is ready for publication. My review includes two parts, the questions suggested by the system and a detailed list of comments.

- Title and abstract
  - Does the title clearly reflect the content of the article? Yes
  - Does the abstract present the main findings of the study? More or less.

I disagree with the affirmation that they found a latitudinal pattern. The effects of differences in tidal conditions seem more relevant.

- Introduction
  - Are the research questions/hypotheses/predictions clearly presented? Yes
  - 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? I don't know

I do not have adequate statistical knowledge to easily follow the statistical method proposed in this MS.

  - Are the methods and statistical analyses appropriate and well described? More or less

In my opinion, the methodology used is a sophisticated statistical method that is not easy to follow according to the explanations in the manuscript. I think it would reach a larger audience if they used a figure to explain the indicators used in the evaluation of the dynamics (especially for NCR and DSDSP). It would also be helpful to provide a brief explanation of what high and low values on these variables mean.

Personally, I do not see the advantage of using the statistical method used. The conclusion seems that it could have been similar applying anovas in figures 5 and 6.

- 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? No

Figure 3 is very important to the manuscript, but the quality is terrible. The shape of the points in the left panels and the variable names in the right panels are not distinguishable. To interpret the right panels, it is also not clear when significant differences can/should be considered.

Figure 4 needs an explanation of how much difference is enough to talk about different behaviors and use a comparable scale between species (the same scale).

- 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)? No

The local scale Zostera spp. strategies do not appear to be well resolved due to a limitation of environmental data. Surprisingly, they give an explanation of the local behavior of TH that then contradicts the results of GM. I believe that section 4.3 is not supported by the data in this manuscript; It's basically a review section.

List of Detailed comments:

- Line 22. I disagree with the affirmation that they found a latitudinal pattern. The effects of differences in tidal conditions seem more relevant.
- Figure 1. An intermediate scale view would be useful to give a correct idea of each system (eg. Lines 118-119 and 123). The large scale image does not need to be that large. Small scale images need indication of

North. It is necessary to improve the image quality to see the scales correctly. You should also name all figures following same pattern (Fig. vs Figure).

- Table 1. It would be great if you include the tidal range (m) in each system and (if possible) the elevation of the Zostera populations with respect to this tidal range. Probably inundation frequency and duration would help as environmental drivers in these dynamics.
- Lines 168 and 174-175. Please add the size of the quadrats and the PVC cores used for sampling.
- Lines 170-171. Please, could you explain how a PVC sheet to cover Z. noltei generates the same observation conditions?
- Lines 204-207. Please, explain how the DSDSP should be interpreted.
- Lines 226-227. I am confused. What means "… where in line with the general environmental description of the sites (Table 1)"? Is Table 1 the environmental data used in your statistical analysis? Or on the contrary, is your environmental data available in Lacoste et al. (2023a)? If the second, you should include a figure with your environmental data.
- Figure 2. Do the red stars represent the seasonal mean per site or the annual mean per site?
- Lines 248-249. I don't clearly see the implications of the net change in NCR. I don't understand why a higher NCR implies few changes from the starting point. Please explain better.
- Figure 3. Very bad quality. Very difficult to see properly. Where is fig.S1?
- Figure 4. Why don't you same scale for same variable when comparing the two species? This figure is not very intuitive.
- Line 333. I do not see a low seasonality on Dshoot for TH. I see no seasonality at all. It is difficult to decide how much difference should be considered significant.
- Lines 338. I do not see that % cover is always higher in GM dynamic modality than in stable one. This is not right on the peak seasons (summer and autumn).
- Lines 363-364. You suggest that the subtidal location of TH population may also be advantageous given the predicted warming in the coming years. However, you do not know if they can tolerate warmer conditions than now. Please support better this suggestion of delete it.
- Lines 386-387. I do not see the similarity in between AC and GM AND TH. AC is a type 2 (typical from light limited environments) and DH and TH have shorter leaves and less light restrictions. Please explain better.
- Line 416. Hydrodinamics is not the same as hydrodynamism. I think you should use hydrodynamic control here.

Additionally, you largely discuss the role of hydrodynamics. Perhaps you should include environmental variables to introduce these effects into your analysis (e.g. frequency and duration of inundation, incidence of waves, …)

- Lines 419-421. What is the validity of a hypothesis that only works in one system? I recommend reworking this part.
- Lines 460-461. I do not see the relevance of mentioning genetic diversity in an isolated sentence. Please, delete it or develop this idea.
- Line 471. You state that your study shows the high adaptive capacities of Zostera spp. to regional and local environmental conditions. However, you also indicate earlier that you don't have enough spatial resolution on your environmental conditions to demonstrate this. Please, change shows by suggest at least.
- Lines 479-480. Recommendations on increasing sampling stations to a local scale should include a warning about the consequences of sampling efforts as anthropogenic pressure, since a very intense sampling effort can be quite destructive in soft sediment environments.
- Lines 487-490. I do not see the relationship of this part with this manuscript. Please, rework these lines with the last paragraph.