

**Subject:**

Authors' Response to SC1 (John Birks)

**Text:**

Thank you for carefully reviewing our manuscript and providing a referee comment in the public review process. Your constructive comments will improve our manuscript. Please find our answers below in blue.

This is an interesting manuscript describing a palaeoecological study in part of the Danube Delta. It is, like many papers about conservation palaeobiology, basically a detailed palaeoecological study with a brief mention of conservation palaeobiology at the beginning and the end of the manuscript. It seems to be that the manuscript is more suited to a biological or palaeoecological journal such as *Palaeo-3*, *Quaternary International*, or some of the marine, freshwater, or aquatic journals such as *Hydrobiologia*.

ANSWER: We think that our paper fits the scope of *Biogeosciences* really well. According to the journal's scope as stated on their webpage, it '...review[s] papers on all aspects of the **interactions** between the biological, chemical, and physical processes. The objective of the journal is to cut across the boundaries of established sciences and achieve an interdisciplinary view of these interactions.' We studied how the interactions between natural and human environmental modification over the past 2000 years effected the endemic mollusc species communities. We use lithological and sedimentological criteria, palaeomagnetic approaches, Pb<sup>210</sup> datings, C<sup>14</sup> measurements, mollusc composition and taphonomy. More important, we integrate very recent observation and collection data that underline the urgent need for action, which makes this paper well different from other conservation paleobiological papers. Our paper is a model example of an interdisciplinary study on the boundaries of five fields that are covered by *Biogeosciences*: biodiversity and ecosystem functioning, biogeochemistry, sedimentary records and palaeobiology.

**Specific comments:**

line 104: fresh water or freshwater – please be consistent

ANSWER: We actually were not inconsistent but chose the spelling according to the following definition: "Freshwater is an adjective used to describe inland bodies of water and things that live in water that is not salty. It is two words—fresh water—when it doesn't function as an adjective. So a freshwater lake, for instance, is one that has fresh water, and a freshwater fish is one that lives in fresh water." (<https://grammarist.com/spelling/freshwater/>). We will check the document carefully again for consistency.

line 132: Did the PVC pipes have a piston? Obtaining a reliable 3m long core with an open PVC tube sounds fraught with problems.

The lakes are very shallow and do not allow boats with piston core facilities. By pushing the pipes in the soft sediment and ensuring they were sealed we were able to create a vacuum when retrieving the cores. Deformation along the core edges was minimal. Sedimentary structures like horizontal beddings were conserved within the sediments proving that the sampling method was successful and representative for changes through time and space of the depositional environment.

line 136: What was 14C dated – bulk sediment, terrestrial macrofossils?

ANSWER: For more information on <sup>14</sup>C dated species we will add another supporting information table: Table S9:

Core	Depth (cm)	Species	Amount of specimens	Weight (in mg, min. 20 mg)
C-03	114	<i>Lentidium mediterraneum</i>	6	40
C-06	120	<i>Ecrobia maritima</i>	16	32
C-07	78	<i>Monodacna</i> sp fragments	8	30
C-07	137	<i>Dreissena polymorpha</i>	1	31
C-10	66	<i>Dreissena polymorpha</i> fragments	6	32
C-13	120	<i>Lithoglyphus naticoides</i>	1	21
C-13	180	<i>Ecrobia maritima</i>	15	30

line 137: How was the calibration done – OxCal, Bchron, Bacon?

ANSWER:

The <sup>14</sup>C ages have been calibrated to calendar years with the software program: OxCal, version 4.3 (Bronk Ramsey, 2017). We used the calibration curve: IntCal13 (Reimer et al., 2013: IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP, Radiocarbon 55(4):1869–1887). We will add this information in the Material and Methods section.

lines 193-203: Why did you not use ter Braak’s canonical correspondence analysis to give you a direct gradient analysis rather than this rather complex two-stage procedure?

ANSWER: We actually considered using CCA at first, but after in-depth study of the literature, we concluded that the analysis is not well suited for our dataset. In their book on Numerical Ecology, Borcard et al. (2011, p. 198) stated the following: “Two important conditions are that the species must have been sampled along their whole ecological range and that they display unimodal responses toward their main ecological constraints.”. Neither of both conditions are met in our case: 1) Some of the species occur under different conditions outside the Razim-Sinoie Lake complex (e.g. in the Caspian Sea or Black Sea lagoons), and 2) the ecological constraints of most species occurring there are poorly studied, so we cannot estimate their detailed response. Because of these limitations we chose to perform an nMDS, which is not bound to these assumptions. There, the surface modelling of environmental data (salinity and grain size) does not affect the ordination plot.

line 204: Given you have 3 a priori groups (your evolutionary species groups), why not do a direct multiple discriminant analysis using the 3 groups? This too can be done in ter Braak’s Canoco program with the unique advantage that the statistical significance of your a priori groupings can be tested using permutation tests.

ANSWER: Using a discriminant analysis would be indeed a useful approach to test if the three groups defined a priori (based on salinity alone) are significantly different. However, our approach was a slightly different one. We wanted to assess if there are ecological groupings (which might be based on more than just salinity). Showing that those groupings indeed correspond largely to the three groups defined

by salinity indicates the relevance of salinity for the species involved. Such an inference would not be possible using discriminant analysis alone.

Kendall's test also includes an a posteriori test to assess the significance of each group.

line 205: Standardisation (subtracting the mean and dividing by the standard deviation) has the effect of giving all taxa equal weight. Is that what you want here?

ANSWER: Yes, indeed, this kind of data transformation was on purpose. It was suggested by Borcard et al. (2011, p. 79). We will explain it in a bit more detail in the revision to avoid confusion.

line 210: What are 'the most encompassing assemblages'?

ANSWER: By 'the most encompassing assemblages' we mean the assemblages that have the smallest number of clusters with the largest number of positively and significantly associated species (see line 211-212). We are not certain whether the reviewer may have missed this explicit explanation.

lines 230-233: Hardly worth saying as Deep-time sediments usually experience postdepositional compaction.

ANSWER: the referral to compaction is in our opinion very relevant. It affects depositional rates as reconstructed here. Outside specialized sedimentological experts, the role of compaction is often not appreciated, hence our referral.

line 403: Is there a word missing, as the sentence does not make sense?

ANSWER: Indeed there is mistake in this sentence. It should read: 'Both the presence of marine Association III species in all cores **and the salinity estimations of mesohaline conditions (Fig. 4)** confirm the idea of a marine bay and show the mesohaline waters from the Black Sea dominated most of the RSL.'

line 540, advice, not 'advise'.

ANSWER: We will change it.