Integrating sedimentological and palaeontological analysis for conservation strategies: the Razim-Sinoie lagoon complex (Danube Delta, Romania) as a model example

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Introduction

The Razim–Sinoie lagoon (Fig. 1) is a dynamic coastal lake system that is considered prime habitat of the unique Pontocaspian species. This fauna has adapted to changes in salinity over time but is now under threat. The lake's salinity depends on relative influx of freshwater from the Danube Delta in the north and influx of mesohaline Black Sea water in the southeast (Fig. 3). Recently, strong anthropogenic modifications resulted in a predominant freshwater system (Fig. 2). The aim of this study is to investigate how mollusk communities responded to a changing environment over time. By analysing facies and mollusk community turnover of thirteen sediment cores, we identify processes and conditions that sustain Pontocaspian species, in order to propose a conservation strategy.

Material and Methods

Thirteen sedimentary cores of 1-2m length were chosen for study. Each core was subjected to a detailed facies analysis. Mollusk samples were taken at 12cm intervals, species were identified and counted. The data were Hellinger-transformed and standardized before K-means partitioning was used on the 20 most abundant species to determine species groups. Kendall's W coefficient of concordance was calculated to find significant species clusters. The final clusters were considered as ecological units characterizing different types of environments (Fig. 4). We calculated the square-rooted summed abundances of the respective species per cluster to get a measure of the relative contribution of each unit per sample (Fig. 2). We are currently working on an age model but initial estimates show that the record represents about 2000 years.

Faunal and facies dynamics through space and time

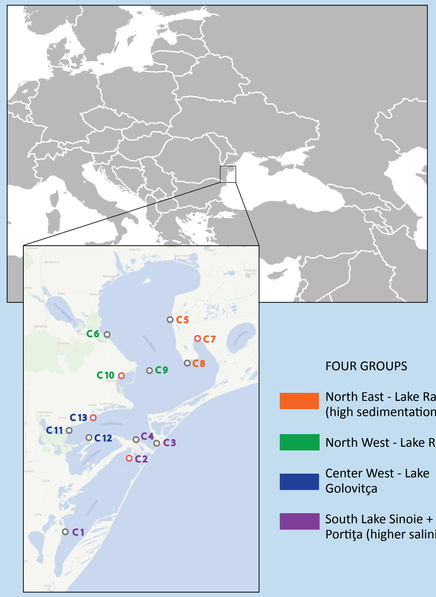

Figure 1. Map of Razim-Sinoie lagoon with locations of thirteen sediment cores. The cores were divided into four groups based on sedimentation rate and current salinity levels. Red pins are the locations of the representative cores for each region, shown in Fig. 2.

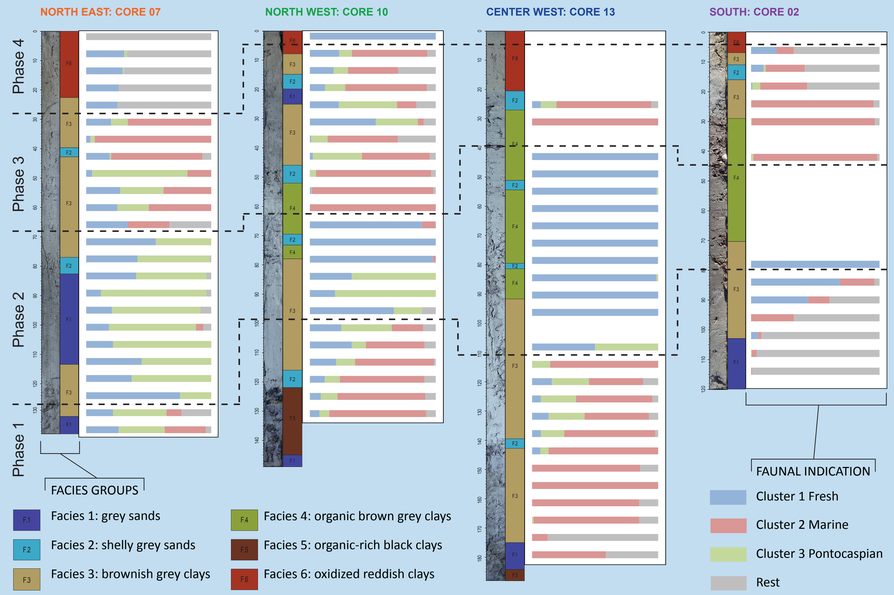

Figure 2. Representative cores for each group: Core picture, facies interpretation and faunal distribution per core. For each sample, we calculated the square-rooted summed abundances of the respective species per unit to get a measure of the relative contribution of each ecological unit per sample.

Four phases, based on fauna indicator species

Phase 4	1900 AD - 2000 AD	Anthropogenic influence: freshwater basin for fish
Phase 3	1600 AD - 1900 AD	Connection to the Black Sea through Golovitca outlet
Phase 2	1200 AD - 1600 AD	Little Ice Age (1250 AD - 1850 AD) + isolation of lakes because of sand bariers
Phase 1	800> AD - 1200 AD	Medieval Warm Period (950 AD - 1250 AD): Higher Black Sea levels

Indicator species per ecological unit

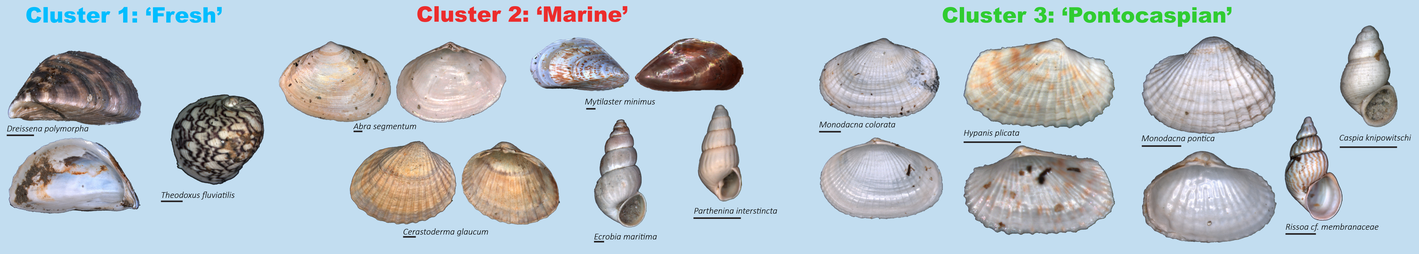

Figure 4. The statistical analysis indicates the presence of three main mollusk assemblages in the abundance data, which are considered as ecological units (based on their salinity preferences). Scale bars under species name correspond to 1mm.

Salinity regimes

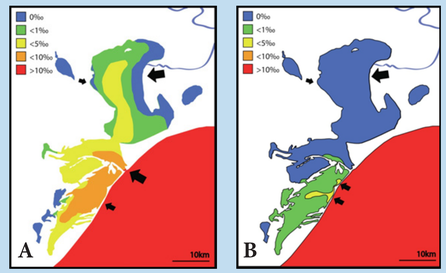

Figure 3. Razim-Sinoie lagoon approximate salinity gradients. A) Situation before the closure of Gura Portita in 1972: strong salinity gradients occurred within the system. B) Situation after the closure of Gura Portita in 1972: the system is freshening because of the limited influence of the Black Sea.

Results

The analysis detected four species clusters. Three of them reflect ecological units: a freshwater, a Pontocaspian and a marine assemblage (Fig. 4). Today, these assemblages are distributed along a north-south salinity gradient. Over the past 2000 years their distribution shifted across the lake system (Fig. 2). The distribution of six sedimentary facies varies through the system showing its environmental evolution with marine and freshwater phases.

Conclusion

The Razim-Sinoeie complex experienced saline, and fresh water phases. The Pontocaspian species live(d) at the interface of brackish and freshwater, and their distributions and abundances fluctuate over time. In the current phase, they appear to have severely declined, which correlates with the anthropogenically-induced freshening of the system. For conservation of the Pontocaspian species, it is imperative to reinstate salinity gradients, for example by reinstalling connections with the Black Sea.

PRIDE: Drivers of Pontocaspian Biodiversity Rise & Demise

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About the author

MSc Sabrina van de Velde has a bachelor in archaeology and in biology. Her field of expertise is palaeobiology and species conservation. She also enjoys science & communication and has been active in reaching out on social media. For PRIDE she keeps the Twitter and Instagram pages up to date.

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