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Shedding light on current developments in Paleo-Ecological Genomics

Kathleen R. Stoof-Leichsenring[1], U. Herzschuh[1,2,3], L. Heinecke[1] and Z. Taranu[4]

1st *sed*DNA Meeting, Potsdam, Germany, 6–9 June 2023

The first sedimentary DNA (*sed*DNA) meeting under the overarching theme "Shedding light on current developments in Paleo-Ecological Genomics" took place from the 6–9 June 2023 at the Alfred-Wegener-Institute (AWI), Helmholtz Centre for Polar and Marine Research in Potsdam, Germany (pastglobal-changes.org/calendar/129294). More than 125 colleagues participated in the first-of-its-kind meeting to bring this scientific community together, to exchange ideas and discuss new avenues.

*Sed*DNA symposium with talks and posters

The first two days consisted of 18 invited keynote talks and more than 80 exhibited posters, of which 62 were presented in the poster lightning sessions. The topics covered Quaternary paleo-metagenomic investigations on lake, permafrost, and marine sediments, as well as archaeological sites, to recover changes of different taxonomic communities (plants, mammals, human, microeukaryotes, etc.) and full ecosystems. Moreover, new method developments on *sed*DNA and *sed*aDNA (sedimentary ancient DNA), and new advances in bioinformatic tools and statistics, were presented.

Talks were followed by a meeting of the *sed*aDNA Scientific Society and a great poster session, including the ice-breaker. Networking events, such as an excursion to the UNESCO World Heritage Site at Park Sanssouci and a conference dinner at the scientific campus at Telegrafenberg in Potsdam, gave everyone the opportunity to connect with other members of the *sed*DNA community.

Method discussions and hands-on workshops

During the third and fourth days, participants dove into methodological discussions during paleo-genetic laboratory tours around AWI, and laboratories led by other ancient DNA research groups were presented to view layouts and set ups. After exchanging experiences and ideas on *sed*DNA methods in nine breakout groups led by early-career researchers (ECRs), four workshops on metabarcoding and metagenomic pipelines, and detecting critical transitions using *sed*aDNA records, the latter as part of the Paleo-Ecological Genomics (PaleoEcoGen) (pastglobalchanges.org/paleoecogen) working group (WG), started in two parallel sessions. Positive feedback was shared throughout the workshop, and peer support by all members of the community was evident throughout.

PAGES PaleoEcoGen workshop

Approximately 25 people took part in a two-day workshop with the PaleoEcoGen WG focusing on the detection of critical transitions in *sed*aDNA data (Fig.1). The first day of the workshop consisted of a statistical tutorial in R, where an example dataset and R script were presented by Zofia Taranu. In particular, three statistical approaches were introduced: 1) Latent Dirichlet Allocation (LDA; also known as Topic Models) to explore how to reduce the dimensionality of *sed*aDNA data by identifying groups of co-varying taxa (i.e. grouping taxa into "community types" or topics); 2) Change-point analysis to identify periods of pronounced turnover in community-types, where given that the approach is a type of fuzzy clustering, two or more community types can co-occur in different proportions within a time period; and 3) Dynamic Linear Models (DLMs) to test whether transitions in community-type occurrences were approached critically. During the second day of the workshop, participants ran the R script on their own, either using the example dataset or their own *sed*aDNA datasets. This gave the group a chance to identify issues and troubleshoot. It was a great opportunity for everyone to work together to improve modeling approaches and cater it to a variety of *sed*aDNA data, most notably those that differ in time frame and dynamics through time.

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AFFILIATIONS

[1]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Polar Terrestrial Environmental Systems, Potsdam, Germany
[2]Institute of Biochemistry and Biology, University of Potsdam, Germany
[3]Institute of Environmental Sciences and Geography, University of Potsdam, Germany
[4]Aquatic Contaminants Research Division, Environment and Climate Change Canada, Montréal, Canada

CONTACT

Kathleen R. Stoof-Leichsenring:
kathleen.stoof-leichsenring@awi.de

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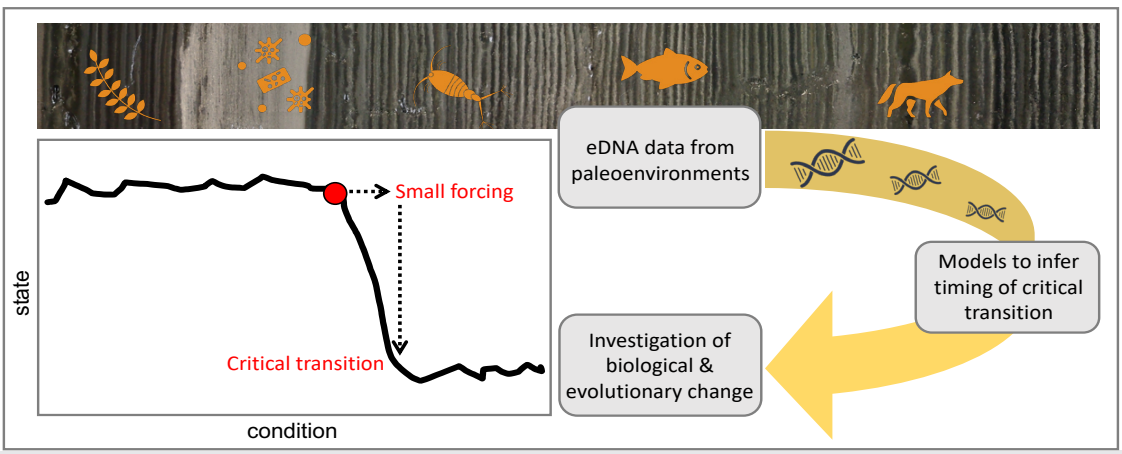

Figure 1: (Left) Schematic representation of a critical transition between two states triggered by a small forcing. (Right) Simplified workflow of the proposed approach to identify past critical transitions, and evaluate subsequent biological changes based on ancient environmental DNA timeseries derived from lake-sediment cores. Modified from Monchamp et al. (2021).