**Title: Decomposing temporal changes of biodiversity to loss, survival, and recruitment of individuals: a cross-scale analysis of Northern-American breeding birds**

**Authors:** François Leroy, Marta Jarzyna & Petr Keil

**Abstract:** Species richness is the most commonly used metric to assess biodiversity crisis, but fluctuations in species number start with fluctuations in the number of individuals (i.e. abundance). Even though species abundances depend on spatial grain (i.e. area of a sampling unit), little is known about the influence of spatial grain on temporal trends in abundance, and abundance-based diversity metrics such as the Shannon index or evenness. Furthermore, the spatial scaling of processes that underpin these abundance-based metrics, such as species’ individuals’ survival, recruitment, and loss is still unexplored.

Here, we empirically address this issue by using the Northern-American Breeding Bird Survey dataset (i.e. BBS) together with the hierarchical Dail-Madsen model accounting for imperfect detection. Using data on 564 bird species over 35 years (1986-2021) in 1033 local time series across North America, we show how the temporal trends of abundance and abundance-based metrics vary with increasing grain size. Additionally, we decompose the temporal changes in species’ abundance into individual survival, loss, recruitment, and their respective probabilities, and we show how the relative scaling of these processes explain the spatial scaling of abundance-based metrics. Thus, we assess 1) how those ecological processes of biodiversity dynamic have changed over 30 years, and 2) how they are influenced by spatial grains.

Disentangling the processes responsible for changes in species abundances (i.e. individual loss, survival, recruitment, and their respective probabilities) is critical to provide insights on the ecological mechanisms responsible for biodiversity changes. Additionally, making this analysis cross-scale (i.e. with increasing grain size) will help better understand which mechanisms are more driving biodiversity changes at local, regional, national and continental scales and thus help conservation decisions.