codyn: Community Dynamic Metrics

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Overview

As long-term datasets increase in scope and length, new analytical tools are being developed to capture patterns of species interactions over time. The package `codyn` includes recently developed metrics of ecological community dynamics. Functions in `codyn` implement metrics that are explicitly temporal, and include the option to calculate them over multiple replicates. Functions fall into two categories: temporal diversity indices and community stability metrics.

Temporal Diversity Indices

Many traditional measure of community structure represent a 'snapshot in time' whereas ecological communities are dynamic and many are experiencing directional change with time. The diversity indices in `codyn` are temporal analogs to traditional diversity indices such as richness and rank-abundance curves. They include:

- `turnover` calculates total turnover as well as the proportion of species that either appear or disappear between timepoints.
- `mean_rank_shift` quantifies relative changes in species rank abundances by taking the sum difference of species ranks in consecutive time points. This metric goes hand-in-hand with "rank clocks," a useful visualization tool for shifts in species ranks.
- `rate_change` analyzes differences in species composition between samples at increasing time lags. It reflects the rate of directional change in community composition.
- `rate_change_interval` produces a data frame containing differences in species composition between samples at increasing time intervals.

Community Stability Metrics

Ecologists have long debated the relationship between species diversity and stability. Unstable species populations may stabilize aggregate community properties if a decrease in one species is compensated for by an increase in another. In a time series, this should be reflected by a pattern in which species negatively covary or fluctuate asynchronously while total community stability remains relatively stable. `codyn` includes a function to characterize community stability, `community_stability`, and three metrics to characterize species covariance and asynchrony:

- `variance_ratio` characterizes species covariance (Schluter 1984; Houlahan et al. 2007), and includes a null-modeling approach to test significance (Hallett et al. 2014). Null modeling is built-in to the `variance_ratio` function. Two additional functions, `temporal_torus_translation` and `temporal_torus_translation_CI`, allow this method to be generalized to other test statistics.
- `synchrony` has two options. The first compares the variance of the aggregated community with the variance of individual components (Loreau and Mazancourt 2008). The second compares the average correlation of each individual species with the rest of the aggregated community (K. Gross et al. 2014).

Citations

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