Temporal homogenization of functional and beta diversity in bird communities of the Swiss Alps

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Abstract: Aim Describing the spatio-temporal dynamics of biotic communities is critical for understanding how environmental change can affect biodiversity. Mountains are especially susceptible to such changes (e.g., climate change) and, consequently, have been identified as ecosystems of conservation concern. With their sharp physical and ecological transitions, altitudinal gradients allow examining the influence of different climatic conditions and land use types on species assemblages across small spatial extents, and thus, they constitute natural laboratories to study diversity–environment relationships. Location Switzerland. Methods We take advantage of long-term (20 years) monitoring data and an extensive trait dataset (100 traits) to examine spatial patterns, temporal trends, and spatio-temporal dynamics in functional and beta diversity of bird communities in the Swiss Alps. Results Functional diversity indices showed a congruent pattern over time and across space; most indices decreased over the study period and were strongly correlated with altitude. In agreement with studies from the tropics, we found that communities in the lowlands were functionally over-dispersed, whereas communities at higher elevations were functionally clustered. High-altitude communities exhibited high functional originality, low levels of niche differentiation and a high turnover rate. Beta diversity declined over the study period. Conclusions Our findings suggest that pastoral abandonment does not result in an increase in avian functional diversity as most species colonizing woody-encroached grasslands are functionally redundant, whereas alpine meadows are inhabited by species exhibiting a high degree of habitat specialization and unique functional traits. Hence, the tree line constitutes a boundary between two well-differentiated functional groups: one representing a functional continuum from lowlands dominated by agricultural landscape to high-mountain forests, and the other one composed of alpine communities. Overall, this study reveals a process of biotic homogenization (i.e., increasing functional similarity) across the last two decades in the Swiss Alps, coinciding with the recently reported increases in the abundance of generalist species.

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\textbf{Aim:} Describing the spatio-temporal dynamics of biotic communities is critical for understanding how environmental change can affect biodiversity. Mountains are especially susceptible to such changes (e.g., climate change) and, consequently, have been identified as ecosystems of conservation concern. With their sharp physical and ecological transitions, altitudinal gradients allow examining the influence of different climatic conditions and land use types on species assemblages across small spatial extents, and thus, they constitute natural laboratories to study diversity-environment relationships.

\textbf{Location:} Switzerland.

\textbf{Methods:} We take advantage of long-term (20 years) monitoring data and an extensive trait dataset (100 traits) to examine spatial patterns, temporal trends, and spatio-temporal dynamics in functional and beta diversity of bird communities in the Swiss Alps.

\textbf{Results:} Functional diversity indices showed a congruent pattern over time and across space; most indices decreased over the study period and were strongly correlated with altitude. In agreement with studies from the tropics, we found that communities in the lowlands were functionally over-dispersed, whereas communities at higher elevations were functionally clustered. High-altitude communities exhibited high functional originality, low levels of niche differentiation and a high turnover rate. Beta diversity declined over the study period.

\textbf{Conclusions:} Our findings suggest that pastoral abandonment does not result in an increase in avian functional diversity as most species colonizing woody-encroached grasslands are functionally redundant, whereas alpine meadows are inhabited by species exhibiting a high degree of habitat specialization and unique functional traits. Hence, the tree line constitutes a boundary between two well-differentiated functional groups: one representing a functional continuum from lowlands dominated by agricultural landscape to high-mountain forests, and the other one composed of alpine communities. Overall, this study reveals a process of biotic homogenization (i.e., increasing functional similarity) across the last two decades in the Swiss Alps, coinciding with the recently reported increases in the abundance of generalist species.