

How has biodiversity of birds changed in time? A global literature review across metrics and spatio-temporal scales

François Leroy, David Storch, Jiri Reif, Petr Keil

Abstract

Biodiversity changes in time due to human impacts and natural processes, and this change affects both ecosystem functioning and human wellbeing. However, empirical quantification of this change remains a challenge even in well surveyed groups such as birds. This may be because the change depends on spatio-temporal scales, specifically on spatial grain (*i.e.* area of a sampling unit), geographic extent, temporal grain (*i.e.* duration of a sampling event), and temporal extent. Further, different metrics of biodiversity may exhibit different spatial trends. Here we review global literature assessing the temporal trends of avian biodiversity from ca 1900AD to present, focusing on studies summarizing trends across many locations (*i.e.* spatial replicates) within a larger region. From each study we extracted direction of average trend (decreasing, increasing, stable), spatial and temporal grains and extents at which trends have been assessed, metrics of biodiversity (taxonomic and functional richness and diversity, evenness, spatial and temporal beta diversity), and location. That is, we list and discuss about the trends of these metrics as a function of the spatial and temporal features they are defined at. We found over 50 trends resulting from averages over spatial replicates. Most studies were from Europe and North America, the rest of the world is represented poorly. There was high heterogeneity in the trends, with increasing, decreasing, and stable trends being all common at all spatial scales. There was no clear tendency of any metric or scale to exhibit a particular direction of the trend. However, our results confirm that biodiversity dynamic can have opposite trends according to the spatial scales considered. Concerning temporal scaling, we point a lack of homogeneity in definitions, and we suggest a common framework to better understand the link between temporal scale and biodiversity dynamic. By bringing all this empirical literature together, we have identified underrepresented regions, times, and metrics that need further attention. We highlight the importance of considering both spatial and temporal scaling jointly in any assessment of biodiversity change. Finally, we provide practical guidelines for how to do this effectively both in birds, and in other taxa, by clearly defining spatio-temporal features in ecology.