Consistency over time, but no evidence of size-structured replacement, in the individual size distributions of North American breeding bird communities

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Background and Methods

How abundance is distributed over the range of body sizes in a community (the individual size distribution, ISD) is a key dimension of community structure. To the extent body size is a proxy for a host of functional traits, the ISD reflects the functional composition of a community. The ISD also links individual species' abundances to ecological function in terms of community-level total biomass and total metabolic flux. Changes in the ISD over time can signal shifts in functional composition, and can decouple the dynamics of abundance, biomass, and energy use. Alternatively, the ISD may remain stable over time, even as the species composition of a community changes, if species of similar body sizes systematically replace each other (size-structured replacement).

In the first macroecological study of the temporal dynamics of terrestrial vertebrate ISDs, we evaluated the change in the ISDs of North American breeding bird communities from 1988-2018, and the consequences for the dynamics of total abundance, biomass, and energy use. Because changes to vertebrate ISDs are intrinsically intertwined with species turnover, we also compared the observed dynamics of ISDs to a null model preserving the observed patterns of species turnover without respect to body size.

Results and Conclusions

Avian ISDs have been highly conserved over time; ISDs from 2014-2018 overlap an average of 80% (CI) with ISDs from 1988-1992. The dynamics of abundance, biomass, and total energy use have been generally coupled, with considerable heterogeneity in the slopes of change and a slight overrepresentation of communities with increasing individual abundance, increasing total biomass and energy use, and [increasing mean body size].

However, we do not detect evidence of size-structured replacement maintaining consistency in the ISD beyond that expected given the observed changes in species composition. Species composition is also conserved in these communities (an average of 60% overlap, CI), and the observed dynamics of the ISD fall well within the outcomes of a null model of species turnover with no respect to body size. To the extent that size-structured processes operate in these communities, a) they may be partially embedded in observed dynamics of species turnover, and b) multiple contrasting processes may operate simultaneously among different groups of species, obscuring a dominant signal. Disentangling these nuanced processes from random

fluctuations, particularly in observational timeseries, will be an important next advance towards a macroecological understanding of the interrelated dynamics of community structure and ecosystem function in terrestrial vertebrate communities.