

Multiple links between species diversity and temporal stability in bird communities across North America

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ABSTRACT

Background: In experimental systems, the temporal stability of entire ecological communities usually increases with the number of species (called ‘species richness’). In contrast, ecology has not discovered the pattern of stability with the complement of richness, which is evenness of species abundances. The job has been more difficult because many measures of species diversity combine richness with evenness.

Questions: Does the correlation of richness with stability occur in natural systems? What is the relationship of evenness to stability? Does diversity increase or decrease the stability of individual species populations? What mechanisms explain the relationships, if any, between diversity and stability?

Data: The 1966–2009 results of 1676 North American Breeding Bird (BBS) survey routes across the USA and Canada. Altogether, 617 bird species were registered with an average of 105 species observed per route. Climate variables were taken from the US National Oceanic and Atmospheric Administration, and Climate Services Canada databases.

Analytical methods: Disentangle richness from evenness and study their separate effects on stability. Perform statistical analysis of biological variables developed from the BBS data. Control for biological and climatic influences.

Results: Both the number of bird species and the evenness of their distributions positively affect the stability of entire bird communities. But richness and evenness do so through a contrasting set of mechanisms. Also, richness and evenness both positively affect the stability of individual populations. The link between evenness and mean population stability can be partly, but not completely, explained in terms of a previously established relationship between the mean and variance of abundance known as Taylor’s Law.

Keywords: biodiversity, community stability, covariance effect, diminishing returns, over-yielding, population stability, portfolio effect, species evenness, species interactions, species richness, Taylor’s Law, temporal stability.

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