Brief Overview on Observations on Biodiversity and Ecosystem Stability

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Commentary

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DESCRIPTION

Climate change and other human-caused (anthropogenic) environmental changes will continue to deplete biodiversity in the coming decades, on top of the already high rates of species extinction occurring globally. Biodiversity is a term that can be used to describe biological diversity at various scales, but in this context, we will focus on species diversity. Because species play critical roles in ecosystems, local and global species extinctions could jeopardise the stability of ecosystem services on which humans rely. Plants, for example, use the sun's energy to fix carbon through photosynthesis, and this vital biological process serves as the foundation of the food chain for a diverse range of animal consumers. Primary production refers to the total growth of all plant species at the ecosystem level, and as we'll see in this article, communities with varying numbers and combinations of plant species can have very different rates of primary production.

Because primary production reflects the rate at which carbon dioxide (a greenhouse gas) is removed from the atmosphere, this fundamental metric of ecosystem function is important for global food supply and climate change rates. There is currently great concern about the stability of both natural and human-managed ecosystems, especially given the numerous global changes that are already taking place. There are several ways to define stability, but the most intuitive definition is one with low variability (i.e., little deviation from its average state) despite changing environmental conditions. This is commonly referred to as a system's resistance. Resilience is a slightly different aspect of stability that indicates an ecosystem's ability to return to its original state following a disturbance or other perturbation.

In recent years, there has been a great deal of research into the relationships between diversity, stability, and ecosystem functioning. The first experiments to test the relationship between diversity and stability manipulated diversity in aquatic microcosms, which are miniature experimental ecosystems with four or more trophic levels, including primary and secondary consumers, and decomposers. These experiments discovered that species diversity provided spatial and temporal stability to a variety of ecosystem functions. Species richness, both within and between functional groups, provided stability. When there are multiple species with similar ecological roles in a system, they are sometimes referred to as "functionally redundant." However, these experiments show that having functionally redundant species can help to ensure ecosystem stability when individual species are lost due to environmental changes such as climate change. More recently, scientists have investigated the role of plant diversity in terrestrial ecosystem stability, particularly in grasslands, where the dominant vegetation is low to the ground and easy to manipulate experimentally. There was significant inter annual variation in climate over the ten years of data collection, and the researchers discovered that more diverse plots had more stable production over time. In contrast, population stability decreased in more diverse plots. These experimental findings are consistent with the theory presented in the preceding section, which predicted that increasing species diversity would be positively correlated with increasing ecosystem stability and negatively correlated with species-level stability due to declining population sizes of individual species.