The Hydrological Niche Plant Diversity Model in Water-limited Ecosystems based on the Evolutionary Stability Theory

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Abstract

The construction of a model that is capable to describe and explain plant diversity is a key in community ecology, which is of great significance in facilitating the analysis and protection of biodiversity.In this paper, the evolutionary stability theory of community water resources allocation is studied in ecologically stable plant communities in water-limited environments, the water consumption of individual biomass growth is used to quantify the hydrological niche of the species, and the arithmetic mean and harmonic mean ratio of hydrological niche of species in the community as a new diversity index is used to measure the community hydrological niche differentiation. An new hydrological niche plant diversity model was established, and the species abundance curve and species area curve including the community hydrological niche differentiation factor were obtained. Through our model derivation and verification, we discovered that the distribution of species abundance in water-limited ecosystems was close to Fisher log series distribution, which unified and expanded the classical diversity theories and discovered quantitative relationship: the larger the degree of community hydrological niche differentiation is, the greater the number of species is with the same abundance. This paper also provides an example for the application of the theory of evolutionary stability to community diversity research.

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