Seasonal shifts in trophic interaction strength drive stability of natural food webs

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Abstract

It remains challenging to understand why natural food webs are remarkably stable despite pronounced variability in environmental factors and population densities. We analysed the dynamics in the structure and stability of the pelagic food web of Lake Constance using seven years of high-frequency observations of biomasses and production, leading to 59 seasonally resolved quantitative food web descriptions. We analysed the dynamics in asymptotic food web stability using maximum loop weight, which revealed mechanisms governing stability. Maximum loop weight showed a recurrent seasonal pattern while indicating consistently high stability despite pronounced dynamics in biomasses and fluxes. This arose from rewiring of the food web structure along seasons, which counteracted destabilization by enhanced productivity. The rewiring originated from energetic constraints within loops and how loops were embedded into food web structure. The stabilizing dynamics originated from the counter-acting effect between high metabolic activity and competitiveness/susceptibility to predation within a diverse grazer community.

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