Microbial size spectra from natural and nutrient enriched ecosystems

Cavender-Bares, Kent K., Andrea Rinaldo, Sallie W. Chisholm

Limnol. Oceanogr., 46(4), 2001, 778-789 | DOI: 10.4319/lo.2001.46.4.0778

ABSTRACT: Microbial size spectra, including bacteria through nanophytoplankton, were measured by use of flow cytometry across the western north Atlantic Ocean and during two nutrient enrichment studies: bottle enrichments in the Sargasso Sea and an in situ iron enrichment in the equatorial Pacific (IronEx II). Spectral shapes, or the relative conformity to a function described by a power law, ranged from smooth and log linear during the spring bloom in the Sargasso Sea to being distinctly non-log linear in coastal waters. Overall, the individual spectra within large regions characterized by similar ecological conditions showed remarkable consistency, inviting speculation that powerful organizing mechanisms are at work in these communities. Moreover, the ensemble average of all of the spectra along the transect displays clear power-law behavior. Slopes ranged from 21.0, in which biomass was equally distributed between all size classes, to 21.4, in which proportionally more biomass was contained in smaller size classes; there was no clear relationship between nutrient concentrations and spectral slopes over the entire data set. Species succession in nutrient-enriched bottles caused spectra to evolve from relatively smooth power laws to distributions showing preferred sizes (i.e., nonlinear on a log-log plot). The IronEx II spectra, however, remained similar over the course of the experiment. It could be that the elimination of bottle effects in this experiment buffered the system in ways that maintained the size structure of the microbial community over the size range we measured. Our results suggest conditions that lead to log-linear size distributions; these should be verified over a broader range of scales and environments.