



Strong bottom-up and top-down control of early life stages of macroalgae

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ABSTRACT: In contrast to most pelagic primary producers, benthic macrophytes pass through morphologically distinct life stages, which can be subject to different ecological controls. Using factorial field experiments, we investigated how grazing pressure (three levels) and nutrient supply (four levels) interact in controlling the passage of marine macroalgae through an apparent recruitment "bottleneck" at the germling stage. In comparative experiments, we asked whether relative bottom-up and top-down effects on early life stages (<4 week germlings) vary (1) between the eutrophic Baltic Sea and the oligotrophic NW Atlantic, (2) across seasons in the NW Atlantic, and (3) among annual and perennial macroalgae. In both systems nutrient enrichment favored and grazers suppressed recruitment of green and brown annual algae; however, enrichment effects were much more pronounced in the Baltic, whereas grazer effects dominated in the NW Atlantic. Grazers induced a shift from grazer-susceptible green to more resistant brown algae in the Baltic without reducing total germling density. In the NW Atlantic, grazers strongly reduced overall recruitment rate throughout all seasons. Effects on perennials were similar in both systems with moderate losses to grazing and no effects of nutrient enrichment. Recruit densities and species composition shifted with season in the NW Atlantic. We conclude that the relative effects of grazers and nutrient enrichment depended on the nutrient status of the system, algal life history strategy, and season. Strong bottom-up and top-down controls shape benthic community composition before macroalgae reach visible size.

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