

How much is too much? Identifying benchmarks of adverse effects of macroalgae on the macrofauna in intertidal flats.

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ABSTRACT

Eutrophication, defined as the accumulation of organic matter typically in response to anthropogenically-enhanced nutrient inputs, often takes the form of macroalgal blooms in shallow estuaries and causes a cascade of adverse ecosystem effects. Confidence in the use of macroalgae as an indicator of eutrophication in estuaries is limited by the lack of quantitative data on thresholds of adverse effects. Field experiments can provide “benchmarks” of no effect or adverse effects that can be used to validate thresholds derived statistically from field data. To determine a benchmark of adverse effects of macroalgal abundance on macrobenthic faunal communities in intertidal flats, experiments were conducted in two sites in Bodega Harbor (BOD) and two sites in Upper Newport Bay (UNB), California, USA. At each site, twenty-four cages maintained six treatments of macroalgae for eight weeks, with mat depths of 0, 1.0, 1.5, 2.5, 3.5 and 5.0 cm comprised mostly of bloom-forming green macroalgae in the genus *Ulva*. Every two weeks, cores of sediment (10 cm deep) were collected and macrofauna were quantified. Mats 1 cm deep, equivalent to a biomass of 110-120 g dry weight (dw) m⁻² or 840- 930 g wet weight m⁻², resulted in the reduction of macrofaunal abundance by at least 67% and species richness by at least 19% within two weeks at three of four sites. Loss was attributed to the decline of key functional groups. Surface deposit feeders were eliminated from one site at BOD within 4 weeks and at one site in UNB within 6 weeks, while 1 cm mats negatively affected suspension feeders and herbivores in the second site at BOD. In contrast, the other site at UNB was not affected by macroalgal treatment, likely due to an initial community comprised of a high proportion of subsurface deposit feeders tolerant of stressful environments. Macroalgal abundances as low as 110-120 g dw m⁻² had significant and rapid negative effects on macrobenthic invertebrates, providing a clear benchmark of adverse effects of macroalgal blooms on macrofaunal abundance and community structure, two indicators of ecosystem health. This information can inform the establishment of appropriate metrics for macroalgal abundance in eutrophic estuaries.

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