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Thresholds of Adverse Effects of Macroalgal Abundance and Sediment Organic Matter on Benthic Habitat Quality in Estuarine Intertidal Flats

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ABSTRACT

Confidence in the use of macroalgae as an indicator of estuarine eutrophication is limited by the lack of quantitative data on the thresholds of its adverse effects on benthic habitat quality. In the present study, we utilized sediment profile imagery (SPI) to identify thresholds of adverse effects of macroalgal biomass, sediment organic carbon (% OC) and sediment nitrogen (% N) concentrations on the apparent Redox Potential Discontinuity (aRPD), the depth that marks the boundary between oxic near-surface sediment and the underlying suboxic or anoxic sediment. At 16 sites in eight California estuaries, SPI, macroalgal biomass, sediment percent fines, % OC, and % N were analyzed at 20 locations along an intertidal transect. Classification and Regression Tree (CART) analysis was used to identify step thresholds associated with a transition from "reference" or natural background levels of macroalgae, defined as that range in which no effect on aRPD was detected. Ranges of 3–15 g dw macroalgaem−2, 0.4–0.7%OC and 0.05–0.07%N were identified as transition zones from reference conditions across these estuaries. Piecewise regression analysis was used to identify exhaustion thresholds, defined as a region along the stress–response curve where severe adverse effects occur; levels of 175 g dw macroalgae m−2, 1.1 % OC and 0.1 % N were identified as thresholds associated with a shallowing of aRPD to near zero depths. As an indicator of ecosystem condition, shallow aRPD has been related to reduced volume and quality for benthic infauna and alteration in community structure. These effects have been linked to reduced availability of forage for fish, birds and other invertebrates, as well as to undesirable changes in biogeochemical cycling.