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Dissolved Organic Nitrogen Inputs from Wastewater Treatment Plant Effluents Increase Responses of Planktonic Metabolic Rates to Warming

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Abstract:

Increased anthropogenic pressures on coastal marine ecosystems in the last century are threatening their biodiversity and functioning. Global warming and increases in nutrient loadings are two major stressors affecting these systems. Global warming is expected to increase both atmospheric and water temperatures and increases precipitation and terrestrial runoff, further increasing organic matter and nutrient inputs to coastal areas. Dissolved organic nitrogen (DON) concentrations frequently exceed those of dissolved inorganic nitrogen in aquatic systems. Many components of the DON pool have been shown to supply nitrogen nutrition to phytoplankton and bacteria. Predictions of how global warming and eutrophication will affect metabolic rates and dissolved oxygen dynamics in the future are needed to elucidate their impact on biodiversity and ecosystem functioning. Here, we experimentally determine the effects of simultaneous DON additions and warming on planktonic community metabolism in the Baltic Sea, the largest coastal area suffering from eutrophication-driven hypoxia. Both bacterioplankton community composition and metabolic rates changed in relation to temperature. DON additions from wastewater treatment plant effluents significantly increased the activation energies for community respiration and gross primary production. Activation energies for community respiration were higher than those for gross primary production. Results support the prediction that warming of the Baltic Sea will enhance planktonic respiration rates faster than it will for planktonic primary production. Higher increases in respiration rates than in production may lead to the depletion of the oxygen pool, further aggravating hypoxia in the Baltic Sea.

Keywords: dissolved organic nitrogen, coastal marine ecosystems, wastewater treatment plant, planktonic community metabolism, respiration, gross primary production