



# Effects of Water Column Mixing and Stratification on Planktonic Primary Production and Dinitrogen Fixation on a Northern Red Sea Coral Reef

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The northern Red Sea experiences strong annual differences in environmental conditions due to its relative high-latitude location for coral reefs. This allows the study of regulatory effects by key environmental parameters (i.e., temperature, inorganic nutrient, and organic matter concentrations) on reef primary production and dinitrogen (N<sub>2</sub>) fixation, but related knowledge is scarce. Therefore, this study measured environmental parameters, primary production and N<sub>2</sub> fixation of phytoplankton groups in the water overlying a coral reef in the Gulf of Aqaba. To this end, we used a comparative approach between mixed and stratified water column scenarios in a full year of seasonal observations. Findings revealed that inorganic nutrient concentrations were significantly higher in the mixed compared to the stratified period. While gross photosynthesis and N<sub>2</sub> fixation rates remained similar, net photosynthesis decreased from mixed to stratified period. Net heterotrophic activity of the planktonic community increased significantly during the stratified compared to the mixed period. While inorganic nitrogen (N) availability was correlated with net photosynthesis over the year, N<sub>2</sub> fixation only correlated with N availability during the mixed period. This emphasizes the complexity of planktonic trophodynamics in northern Red Sea coral reefs. Comparing mixed and stratified planktonic N<sub>2</sub> fixation rates with those of benthic organisms and substrates revealed a close seasonal activity similarity between free-living pelagic and benthic diazotrophs. During the mixed period, N<sub>2</sub> fixation potentially contributed up to 3% of planktonic primary production N demand. This contribution increased by ca. one order of magnitude to 21% during the stratified period. Planktonic N<sub>2</sub> fixation is likely a significant N source for phytoplankton to maintain high photosynthesis under oligotrophic conditions in coral reefs, especially during stratified conditions.

**Keywords:** plankton, primary production, dinitrogen fixation, Gulf of Aqaba, diazotrophs