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RESEARCH ARTICLE

Contrasting seasonal responses in dinitrogen fixation between shallow and deep-water colonies of the model coral *Stylophora pistillata* in the northern Red Sea

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Abstract

Tropical corals are often associated with dinitrogen (N_2)-fixing bacteria (diazotrophs), and seasonal changes in key environmental parameters, such as dissolved inorganic nitrogen (DIN) availability and seawater temperature, are known to affect N_2 fixation in coral-microbial holobionts. Despite, then, such potential for seasonal and depth-related changes in N_2 fixation in reef corals, such variation has not yet been investigated. Therefore, this study quantified seasonal (winter vs. summer) N_2 fixation rates associated with the reef-building coral *Stylophora pistillata* collected from depths of 5, 10 and 20 m in the northern Gulf of Aqaba (Red Sea). Findings revealed that corals from all depths exhibited the highest N_2 fixation rates during the oligotrophic summer season, when up to 11% of their photo-metabolic nitrogen demand (CPND) could be met by N_2 fixation. While N_2 fixation remained seasonally stable for deep corals (20 m), it significantly decreased for the shallow corals (5 and 10 m) during the DIN-enriched winter season, accounting for less than 2% of the corals' CPND. This contrasting seasonal response in N_2 fixation across corals of different depths could be driven by 1) release rates of coral-derived organic matter, 2) the community composition of the associated diazotrophs, and/or 3) nutrient acquisition by the *Symbiodinium* community.

Introduction

Scleractinian corals are effectively composed of an assemblage of diverse organisms (often referred to as the coral 'holobiont') including the cnidarian host, endosymbiotic dinoflagellates (of the genus *Symbiodinium*), bacteria, archaea and fungi [1]. *Symbiodinium* provides the heterotrophic coral host with carbon (C)-rich photosynthates that are essential for host survival