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The ability of endosymbiotic *Symbiodinium* to fix inorganic nutrients and their translocation to the coral host is considered a key element for the growth of coral reefs in tropical coastal waters and has been a fundamental research topic for over 50 years. With pulse-chase experiments using stable isotopes and combined TEM and NanoSIMS ultrastructural and isotopic analyses it is now possible to visualize and quantify the fixation, translocation, and turnover of essential elements such as carbon and nitrogen with unprecedented subcellular resolution. With these techniques we have monitored the assimilation of ^{15}N nitrate, ^{15}N ammonium, and ^{13}C bicarbonate in the coral *Pocillopora damicornis*. These studies have revealed dynamic intra-symbiont storage of assimilated nitrate and ammonium in the form of uric acid crystals, and the formation of lipid droplets and starch granules in the symbiont and their subsequent remobilization. Carbon translocation toward the coral gastrodermal lipid droplets was detected within 15 min. Moreover, glycogen granules in the coral tissue were found to be an important sink for translocated carbon. This work has now been extended to the related pocilloporid species, *Stylophora pistillata*, with the important addition of heterotrophy (feeding the coral with dual-labelled brine shrimps) to contrast the fate and timeframes of heterotrophic vs. autotrophic (^{15}N nitrate/^{13}C bicarbonate) nutrient uptake under natural conditions and environmental stress due to elevated water temperatures. The *in situ* spatial data provided by NanoSIMS allow us for the first time to address questions that cannot be answered by traditional bulk measurements, such as: (1) the influence of local symbiont densities on individual *Symbiodinium* assimilation rates, (2) metabolic capabilities of different symbiont ITS2 types *in hospite*, and (3) the effect of changes in intracellular host and symbiosome pH on individual symbiont productivity.

6OR.9

CRITICAL ROLE OF OXYGEN PHOTOREDUCTION DOWNSTREAM OF PSI IN *SYMBIODINIUM*: PHOTOPROTECTION, ENERGETIC ADJUSTEMENT AND ROS PRODUCTION

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The ecological success of symbiotic cnidarians (reef building-corals and sea anemones) relies on the symbiosis between cnidarians and photosynthetic dinoflagellates of the genus *Symbiodinium*. Photosynthetic organisms have evolved various photoprotective and regulatory mechanisms to cope with changing and high light intensities, but the nature and relative amplitude of these mechanisms is still a matter of debate in *Symbiodinium*. Few studies showed that molecular oxygen (O_2) can be an efficient electron sink during photosynthesis in *Symbiodinium*, with an O_2 uptake capacity that could represent up to half the maximum O_2 evolution. In addition, members of clade A *Symbiodinium* were proposed to possess enhanced capabilities for alternative photosynthetic electron flows. In this work, the amplitude of photosynthetic alternative electron flows to oxygen (chlororespiration, Mehler reaction, mitochondrial respiration) and PSI cyclic electron flow was investigated in *Symbiodinium* strains belonging to different Clades (A, B and F). Joint measurements of oxygen evolution, PSI and PSII activities allowed us to demonstrate that photoreduction of oxygen downstream PSI by the so-called Mehler reaction is the main alternative electron sink at the onset and steady state of photosynthesis in all strains[1]. This mechanism in *Symbiodinium* sustains significant photosynthetic electron flux under high light, thus acting as a photoprotective mechanism and modifying the ratio of ATP/NADPH to match the requirements of carbon reduction. At higher temperature (26 to 33°C), the amplitude of Mehler reaction was still significantly increased while the capacity of enzymes responsible for superoxide detoxification largely decreased. This imbalance generated twice more ROS than during the treatment at 26°C, suggesting that under conditions known to induce coral bleaching, the photoprotective role of Mehler reaction can no longer be maintained, at least at short term.

6OR.10

METABOLIC RESPONSES TO CHRONIC NUTRIENT STRESS DIFFER BETWEEN *SYMBIODINIUM* PHYLOTYPES