Transcriptomics response of thermally preconditioned *Pocillopora damicornis* to heat stress

Louis Y.D. [1,2,3*], Montalbetti E.[1,2,3], Isa V.[1,2,4], Maggioni D.[1,2], Madaschi A. [1,2], Toniolo L.M[1,2], Gobbato J.[1,2], Montano S. [1,2,3], Lavorano S.[4], Galli P. [1,2,3], Seveso, D. [1,2,3]

[1] *Earth and Environmental Science Department, University of Milano Bicocca, MI 20126, Italy*

[2] *MaRHE Center (Marine Research and High Education Center), Magoodhoo Island, Faafu Atoll, Maldives*

[3] *NBFC (National Biodiversity Future Center), 90133 Palermo, Italy*

[4] *Costa Edutainment SpA - Acquario di Genova, GE 16128, Italy*

** Presenting author e-mail: yohan.louis@unimib.it*

Thermal preconditioning has been demonstrated to enhance bleaching tolerance in tropical reef-building corals, offering potential applications for coral farming and restoration, and assisted evolution strategies. Although experimental evidence supports the efficacy of thermal preconditioning in increasing tolerance in corals, the molecular mechanisms underpinning this process remains poorly understood. Limited investigations have been conducted on the molecular basis, with only few coral species being the focus of such studies. Therefore, in this study, colonies of *Pocillopora damicornis* were subjected to thermal preconditioning through controlled exposure to sub-lethal temperature (28 ^{o}C, for 2 weeks), simulating conditions that induce increase tolerance in previous studies. Non-preconditioned colonies were maintained under lower stable conditions (25 ^{o}C). All experimental groups were then subjected to a heat stress of 33 ^{o}C. RNA was extracted from coral samples, and high-throughput RNA sequencing was employed to determine the transcriptome-wide changes in gene expression. Bioinformatics analyses were conducted to identify differentially expressed genes, pathways, and functional categories. The transcriptomic analysis revealed significant differences in gene expression profiles between preconditioned and non-preconditioned *P. damicornis* colonies. Key stress-response genes were upregulated in preconditioned corals, indicating the activation of adaptive heat-stress mechanisms. Additionally, genes associated with symbiotic relationships and antioxidant defense mechanisms exhibited distinct expression patterns. The non-preconditioned colonies displayed a less pronounced stress-responsive transcriptomic signature, suggesting reduced preparedness for future thermal-stress events. These findings provide a comprehensive understanding of the molecular dynamics governing thermal preconditioning in coral. Overall, this investigation will contribute to bridge the knowledge gap surrounding the molecular mechanism of thermal preconditioning, providing essential insights for the practical implementation of this technique in conservation strategies.