The Molecular Basis of Heat-Stress Memory in *Cymodocea nodosa:* the interplay between DNA methylation and gene expression

Martina Lazioli[1]*, Gabriele Procaccini[2], Jessica Pazzaglia[2]
*lead presenter: martina.lazioli@imbrsea.eu
1 International Master in Marine Biological Resources (IMBRSea), Belgium
2 Stazione Zoologica Anton Dohrn, Napoli (Italia)

Seagrasses are marine plants increasingly exposed to climate-driven stressors such as marine heatwaves (MHWs), which threaten their resilience and long-term survival. To cope with such environmental stressors, they display stress memory mechanisms, at basis of priming, which enhance tolerance to recurring stress events. In terrestrial plants, epigenetic modifications such as DNA methylation are thought to contribute to these processes by linking stress exposure to changes in gene expression. However, the molecular basis of stress memory in seagrasses and its persistence across generations remains poorly understood.

In this study, we investigated the relationships between DNA methylation and gene expression by selecting candidate genes based on differential methylation patterns and quantifying their expression across different treatments and clonal generations, through RT-qPCR.

The analysis builds on a previously generated methylation dataset obtained from a thermal priming experiment in the Mediterranean seagrass *Cymodocea nodosa,* a fast-growing species characterized by clonal propagation and high plasticity, characteristics that make it a well suited model for these types of studies.

Our results show that global gene expression patterns were significantly influenced by the interaction between treatment and clonal generations. However, when analyzed at gene-level, responses were highly heterogeneous. Moreover, a small but significant negative association between DNA methylation and gene expression was observed, with stronger effects in promoter regions.

Overall, these findings highlight a complex interplay between DNA methylation and gene expression dynamics in shaping stress memory and its potential transmission across clonal generations in the seagrass *C. nodosa*, with responses being gene-specific and context-dependent.