Exploring Assisted EVOLution approaches for improving SEAgrass restoration and for enhancing the resilience of restored populations (AEvol-Sea)

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Abstract

In this research, I explored non-invasive assisted evolution strategies on seagrasses to establish effective protocols for (i) pre-conditioning genotypes to increase their stress-tolerance and (ii) identifying genotypes that are already stress-adapted. The identification of high-performing genotypes is useful to improve seagrass-based ecosystem restoration. In **Chapters 2** and **3**, I provided evidences that the primed state (i.e stress memory) acquired by seedlings of *Posidonia oceanica* after a first stress exposure is not permanent, but rather temporary adjustment that helps the plant to respond more quickly to recurrent stress. In the second study, new data related to genes associated with transcriptional memory were provided. In **Chapter 4**, I observed that the phenotypic screening tests on seeds of *P. oceanica* are important for identifying seeds that enhance seedling viability in the early months, leading to more successful transplantation (i.e. larger-seeded seedlings showed faster and stronger growth than smaller seed seedlings). However, further research is needed to assess the role of seed reserves in preventing heat stress, as larger-seeded seedlings do not demonstrate increased resistance to heat stress. In **Chapter 5**, I investigated differences in temperature resilience between *Zostera marina* populations from areas characterized by different thermal regimes (shallow/warm and deep/cold). The identification of locations with thermal tolerant populations at a small spatial scale is important to identify sources of stress-resistant seagrasses for active restoration, through Assisted Gene Flow, and conservation measures within the same distribution region. scenarios. The analyses for this project are still ongoing; however the preliminary observations offer an initial idea of how the tested populations responded to the experimental conditions.

This thesis offers pioneering insight into the efficacy of non-invasive strategies of assisted evolution technologies in providing genotypes or identifying seagrass genotypes with a critical capacity to adapt at a pace closer to that of current climate change trajectories.