

Miriam Ruocco (M.Sc.)

**Unravelling the complexity of the molecular and
physiological response to environmental change in
seagrasses**

Doctor of Philosophy

School of Life, Health and Chemical Sciences

Open University UK

Stazione Zoologica Anton Dohm

Department of Integrative Marine Ecology

Director of studies

Dr. Gabriele Procaccini

Stazione Zoologica Anton Dohm

Department of Integrative Marine Ecology

Villa Comunale

80121 Napoli

Italy

External supervisor

Prof. Fabio Bulleri

Universit di Pisa

Department of Biology

Unit of Ecology and Marine Biology

Via Derna 1

56126 Pisa

Italy

September 2018

Abstract

This thesis explores the complexity of seagrass stress response in the face of current environmental changes. This is a timely and relevant issue due to the role supplied by these foundation species in coastal ecosystems, and the dramatic consequences their loss would cause on marine biodiversity and human well-being.

Using as target species the iconic Mediterranean seagrass *Posidonia oceanica*, here I show: i) how molecular reprogramming, acting primarily at gene-expression level, coordinates physiological and morphological responses to different stressors, and ultimately determines species' acclimation strategies and tolerance capacity; ii) the differential stress response existing within and among different organs, and between different shoot types; iii) how the response to a single stressor can be modified depending on its temporal variability, and due to the interaction with another stressor.

In this study, new transcriptome data have been generated, from leaves and shoot-apical meristems, increasing considerably molecular resources available for future studies on seagrass evolutionary ecology and functional genomics. Moreover, this research sheds first light on the stress response of organs other than leaf, in seagrasses, and recognises the shoot meristem as a key determinant of whole plant survival.

Common and stress-specific molecular biomarkers have been identified through different approaches, and their potential applicability as sub-lethal stress indicators can be verified in the future with ad hoc experiments.

Another important aspect of this study is the recognition of the importance of epigenetic variations, specifically DNA methylation changes, as key mechanisms for phenotypic accommodation and adaptive responses to environmental changes in seagrasses.

Tolerance capacity of the species to main current threats of coastal areas, namely the reduction of available light, heat stress, eutrophication and herbivory, is discussed in light of the results obtained from the different experiments.

Keywords: Abiotic and biotic stressors, *Posidonia oceanica*, Light, Heat stress, Eutrophication, Herbivory, Multiple stressors, Temporal variability, Leaf, Shoot-apical meristem, Plagiotropic and orthotropic shoots, Tolerance