UNIVERSITÀ
DEGLI STUDI
DI TRIESTE

UNIVERSITÀ DEGLI STUDI DI TRIESTE

XXXVI CICLO DEL DOTTORATO DI RICERCA IN

AMBIENTE E VITA

Co-financed by Stazione Zoologica Anton Dohrn

Diatom associations on seagrass meadows: Effects of Ocean Acidification on the first colonization and plant-animal chemical relationships

Settore scientifico-disciplinare: BIO/07 ECOLOGIA

DOTTORANDO / A
EMANUELE SOMMA

COORDINATORE
PROF. GIORGIO ALBERTI

SUPERVISORE DI TESI
PROF. ANTONIO TERLIZZI

CO-SUPERVISORE DI TESI
DR. VALERIO ZUPO

ANNO ACCADEMICO 2022/2023

ABSTRACT

The atmospheric CO_2, primarily caused by combustion of fossil fuels, cement production and land use changes, is being absorbed by the ocean at faster rate since the beginning of the industrial era. This phenomenon, known as ocean acidification (OA), is considered one of the main threat for the marine communities. Among global environmental changes, OA is causing both direct and indirect effects to the marine life, and one of the main challenges for scientists, managers, and policy-makers is understanding how the ecosystems will respond to these changes, considering the 'winners' and the 'losers' species in their entirety. In this context, shallow CO_2 vents provide potential analogues of forecasted acidified ocean and represent a great opportunity to understand the responses of species and communities long-term exposed to low pH conditions.

Vents are locally acidified environments that are used worldwide as natural laboratories to test acidification effects not only on single species, but also on whole communities, evaluating indirect effects on ecosystems. Primary producers, such as seagrass meadows, may take advantage from the higher seawater CO_2 levels. In particular, the foundation species *Posidonia oceanica* has a key importance for the Mediterranean Sea, for all the ecosystem services that it supports. Under naturally acidified conditions (*i.e.*, shallow volcanic CO_2 vents), *P. oceanica* increases its habitat complexity but lower the abundance of epiphytic calcareous species (*e.g.*, coralline algae). Among the epiphytes that live associated with *P. oceanica* leaves, a relevant ecological role is covered by benthic diatoms. Benthic diatoms represent key organisms riding through primary and secondary biofilm formation, playing important roles in determining the structure and the dynamic of the overlying benthic communities. For this reason, they represent important elements in the determination of colonization patterns.

Here, the current PhD research aimed to assess the effect of high pCO$_2$ / low pH conditions on the structural and functional organization of benthic diatoms assemblages in a Mediterranean shallow CO_2 vent. First, by reviewing the available literature, we summarize the present knowledge about the impacts of OA on the early colonisation stages and the succession of benthic communities over time (Chapter 1). Then we collected epiphytic diatoms through ad-hoc developed low adhesive sampling panels capable of selecting mainly the early colonization stages. Thus, we were able to reconstruct the benthic diatoms assemblages belonging to different pH conditions (acidified versus control sites) thanks to the morphological identification base on the analyses of frustule ultra-structures on Scanning Electron Microscope (SEM) images (Chapter 2). Exploiting the collected samples, we also isolated, selected and cultured new axenic monoclonal benthic diatoms. Special attention was paid to the identification through a polyphasic approach (molecular and morphological) of a well-established model diatom isolated: *Cocconeis neothumensis* var. *marina* (Chapter 3). In this view, my research work focused on the ecophysiology of diatom strains selected in nature under different pH conditions. In particular, the possible effects of ocean acidification on the growth and metabolism of the two cultured strains were tested (see Chapter 4). Finally, we tested the effect of OA on the plant-animal chemical relationships. In particular, the benthic diatoms of the genus *Cocconeis*, dominating benthic communities associated with *P. oceanica*, are known for the production of apoptogenic compounds influencing the early sex reversal of the decapod *Hippolyte inermis*. To this purpose, we approached this issue by exploring the responses of *H. inermis* to different food source. In particular, we carried out a bioassay experiment supplying to the post-larvae two strains of *C. neothumensis* isolated both from control and low pH sites (Chapter 5).