UNIVERSITY OF MESSINA

Department of Chemical, Biological, Pharmaceutical and Environmental Sciences

Ph.D. course in Applied Biology and Experimental Medicine

XXXVI Cycle

SSD: BIO/07

Investigation of the response in two demersal fish species: *Coris julis* and *Serranus scriba* under ocean acidification conditions in the CO_2 vent of Ischia (Italy)

Ph.D. Thesis of:

Luca Pagano

Tutor Unime:

Prof. Gioele Capillo

Tutor SZN:

Dr. Pierpaolo Consoli

Coordinator:

Prof. Emanuela Esposito

Academic Year 2022/2023

Abstract

In the last 200 years, the CO_2 concentration in the atmosphere has significantly increased because of human activities. About 30% of the anthropogenic CO_2 emissions in the atmosphere have been absorbed by the oceans, causing a decrease in the seawater pH of 0.1 unit. Climate predictions suggest that pH will further decrease by 0.3 units by 2100 reaching the value of 7.3 in 2300.

Ocean acidification caused by anthropogenic activity is known to affect wild animals in the ocean with unforeseen consequences for survival and biodiversity. Evaluating how marine species might adapt to predicted environmental conditions in the near future is challenging. The present study is directed at resident wild fish that inhabit natural acidified seawater due to venting of CO_2 by hydrothermal vents. The direct effects of acidification, as predicted in climate change scenarios, were investigated in the Mediterranean rainbow wrasse *Coris julis* (Linnaeus, 1758) and painted comber *Serranus scriba* (Linnaeus, 1758) by the use of a natural acidified area. The study was conducted in the Ischia shallow vent systems (Gulf of Naples). The environmental conditions around Ischia provide a natural laboratory and a unique opportunity to study the response of the organisms to future climate change conditions. At this aim, a mineralogical and a molecular approach were carried out:

1) structure and composition of fishbone Hydroxyapatite (HAP) was evaluated in these two species in order to highlight potential physiological effects due to exposure to natural acidification.
2) 16S sequencing was carried out to determine the response of fish endogenous microbiota to acidified conditions.

The results obtained from this project suggest that both species respond to environmental conditions, even though in different ways. The skin microbial composition was species-dependent, whereas the mineralogical features of skeleton were mainly influenced by age. However, the skin microbial community

of *S. scriba* exhibited a significant disturbance when it was associated with low pH site compared to *C. julis*, which showed no particular variation between sites, thus indicating that there is a species-specific response to environmental conditions. Moreover, a moderate skeleton maturation was also found in fish exposed to acidified conditions than in control.

In light of the obtained results, there is a need for further clarity regarding the mechanisms that fish engage under unusual environmental conditions, reflecting the future climate change scenario predicted for 2100. The results also confirm that these naturally acidified areas of CO_2 vents represent a valuable resource for researchers who intend to study the responses of marine organisms to acidification.