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ENVIRONMENTAL QUALITY IMPROVEMENT AFTER THE CONVERSION OF A MARICULTURE PLANT INTO AN INTEGRATED MULTITROPHIC AQUACULTURE (IMTA) SYSTEM

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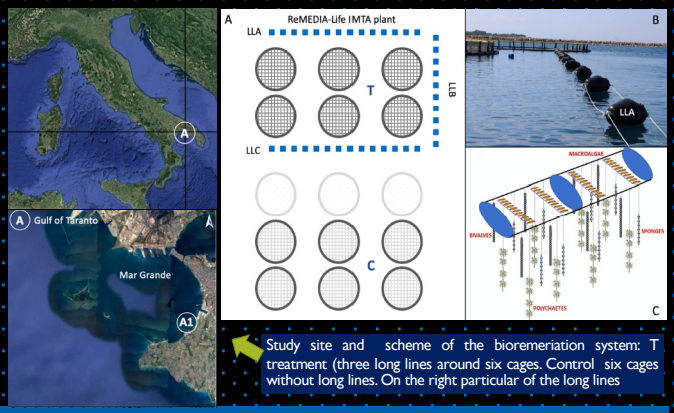
INTRODUCTION

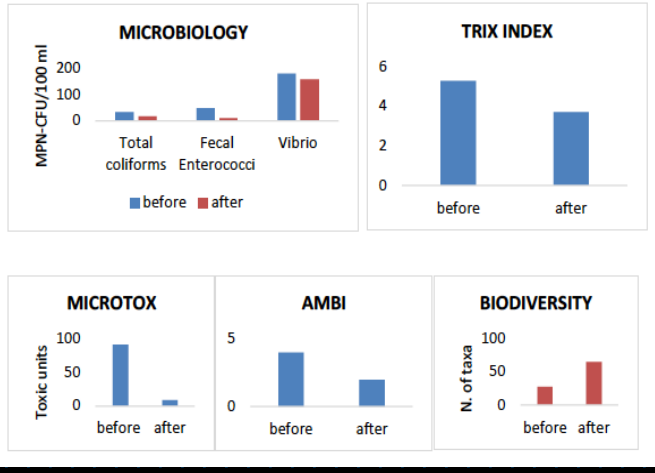
Mariculture activities strongly affect the surrounding environment (Gentry *et al.,* 2017). Wastes deriving from these activities are the main cause of negative environmental impacts influencing water quality and benthic communities (Wang *et al.,* 2020). Within the project Remedia life, a fish mariculture plant (Maricoltura Mar Grande of Taranto) was converted into an Integrated Multi-Trophic Aquaculture system (IMTA), utilizing a new set of very efficient bioremediating organisms (polychaetes, porifers, mussels and macroalgae). To investigate the restoration effect occurring after the conversion of the plant, an environmental monitoring program was performed at the beginning of the project (Giangrande et al., 2022) and repeated after two years of the IMTA system establishment. In order to obtain a detailed description of the environment, both water column and sediment were sampled.

MATERIAL AND METHODS

The study area is located on the south-west side of the Mar Grande of Taranto (40°25′56″ N; 17°14′19″ E) (Ionian Sea), which is a semi-enclosed basin connected to the Gulf of Taranto.The investigation was performed in the aquaculture plant "Maricoltura del Mar Grande (MMG)", partner of the Remedia-Life project. Two sampling areas were identified around the fish farm, with 4 stations located at the four corners of the plant. Samples were collected one year before (2018) and two years after the realization of the IMTA system. Physical-chemical and microbiological parameters and TRIX index were measured in the water, whilst microbiological parameters and macrobenthic analysis were conducted in the sedimentary environment, considering the AZTI's Marine Biotic Index (AMBI) and microtox bioassay. Moreover, the changes in biodiversity of hard substrates present under the cages were also investigated.



Study site and scheme of the bioremeriation system: T treatment (three long lines around six cages. Control six cages without long lines. On the right particular of the long lines



Changes over time in the Treatment station of A) water column parameters (microbiology analysis and TRIX index) and of B) sediment, soft and hard bottom parameters (Microtox, AMBI and biodiversity).

RESULTS

The ex ante analysis allowed to asses the more impacted station due to the aquaculture activities. By comparison, the other three stations were characterized by a higher environmental quality, therefore the more impacted station was chosen to experiment the bioremediating activity and considered as the Treatment station (T). Another station, without bioremediators, was utilized as Control (C). An amelioration of the Treatment station was observed after the conversion of the plant. By contrast the Control station remained quite similar throughout the years, leading to conclude that the bioremediating activity determined a similarity of the environmental condition in the investigated stations, towards an amelioration of T station at the end of the project. The changes observed over time in T station of both water column and sediment parameters are reported in the following figure (Fig. 1).

DISCUSSION

In the realized IMTA system the bioremediating organisms grew without adding any feed other than the fish one. The synergistic action of all the bioremediators reared around the fish cages restored the water column by transforming the waste into biomass that can be utilized as a by-product of aquaculture. More in particular, macroalgae avoid the eutrophication of the water surrounding the fish cages, whilst the filter feeders, such as worms, sponges and molluscs remove bacteria and particulate organic matter, improving the microbiological quality of the water as well as the transparency. Our results indicate that the marine environment benefits from the eco-sustainable potential of this method. The values of the parameters selected as indicators of environmental quality, such as TRIX index, AMBI microtox bioassay, microbiological analyses and hard bottom biodiversity evaluation, have significantly showed an amelioration of the Treatment site. This was particularly true for the indicators related to the sediment compartment which represents the biological memory of the system. In fact, the environmental quality under the cages, once highly degraded, was recovered with a remarkable increase in local biodiversity. Our results are noteworthy since for the first time the bioremediation effect was *in situ* measured.

maricoltura MAR GRANDE

References

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