EVALUATING ECOLOGICAL COMPATIBILITY AND ORGANIC WASTE BIOREMEDIATION IN MARINE INVERTEBRATES: AN INTEGRATED MODEL OF SUSTAINABLE BLUE GROWTH

PhD Student: Luca Grosso/ *Supervisor*: Prof. Michele Scardi / *Co-supervisor*: Dr. Arnold Rakaj

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Aquaculture is the world's fastest growing food sector and it provides more than 17% of all animal protein consumed by the global human population. However, although aquaculture is considered the most promising sustainable alternative to meet the current market demand while preserving the natural populations, there are downsides to its enormous growth. In fact, the fishery dependence for the supply fishmeal and feedstuff and the production of large quantities of organic pollution are economically and environmentally unsustainable in the long term. For this reason, in the last few decades a new-generation and more sustainable aquaculture system, called Integrated Multi-Trophic Aquaculture (IMTA), has been conceived. This integrative approach, in fact, offers a natural means of encouraging nutritional recycling within aquaculture farms, simulating a natural community thanks to the addition of extractive species with a low trophic level and high market value. On this line of diversification and reduction of environmental impact of commercial productions, sea urchin and sea cucumber are promising candidates for co-culture in IMTA. Indeed, sea urchins and sea cucumbers are considered a culinary delicacy in high demand from consumers due to their unique organoleptic features and nutraceutical properties. The increasing market value, however, is driving the overfishing on these species that are leading to the fast decline or even collapse of natural stocks. This phenomenon is very harmful to the biodiversity of benthic communities and the health of the sediment inhabited by these echinoderm species, since they both have important ecological roles. In addition, sea urchins and sea cucumbers belong to low trophic level species with a very low animal protein requirement. Indeed, predominantly herbivorous animals, such as sea urchins, are traditionally considered to be relatively low-input and thus a sustainable species. Sea cucumbers, on the other hand, are detritivores which are capable of ingesting and processing particulate organic by-products, making them prime candidates for value-added bioremediation of aquaculture waste solids derived from intensive farming. However, although sea urchins and sea cucumbers co-exist in many marine habitats and their feeding behavior seems highly compatible (e.g. in seagrass meadows), there are no investigations available regarding the co-culture of Mediterranean species. Therefore, my project aims: I) to evaluate for the first time the feasibility of an IMTA system combining sea urchins as the primary species and sea cucumbers as extractive species; II) to assess a more sustainable aquaculture of high market value species using feed resources from lower trophic levels than fish meal supplement; III) to obtain information on the biological processes that govern the degradation kinetics of organic matter in detrital food chains and aquaculture effluent treatment systems, in order to understand the benefits of IMTA on mitigating the impact of farms in an aquatic environment; IV) to boost the basic knowledge of the feeding behavior of sea urchin and sea cucumber species and the rearing techniques to adopt in order to provide an alternative to exploitation of wild stocks.