Integrated multitrophic aquaculture for efficiency and environmental conservation

Aquaculture is facing a double challenge: producing more to sustain a growing demand for aquatic products and preserving the environment. Integrated Multi Trophic Aquaculture (IMTA) is one of the most promising pathways in the evolution of aquaculture systems. IMTA is based on the integrated cultivation of aquatic organisms belonging to different and complementary trophic levels. Inorganic and organic wastes from fed aquaculture organisms (e.g. finfish) are assimilated by respectively, autotrophs (phytoplankton, macroalgae, plants) and heterotroph species (oysters, mussels, sea cucumbers) that are co-cultured with the fed organisms. IMTA systems are designed in order to:

- Decrease the dependence on external inputs, and increase the system efficiency by optimizing the use of nutrients and energy in the production loop,
- Decrease the waste effluent and bio-deposit impacts by limiting the loss of nutrients (in water, sediments and air)
- Diversify farm- products and generate a more robust source of income (less dependent on mono-product markets)
- Generate and use different types and levels of ecosystem services

There are several IMTA strategies that use different approaches of integration either by growing each trophic level separately in a cascade of water waste concentrations or by growing different trophic levels all together.

The project IMTA-Effect aims to generate and integrate knowledge in order to design IMTA strategies for fish farmers being efficient, economically attractive, robust, and environmentally friendly, in marine and freshwater aquaculture systems. For this purpose, the project will combine experimental and modelling approaches to provide knowledge on the nutrient and energy efficiency gains generated by associating different aquatic species of different levels in the food web. Two basic production systems with various forms will be studied: multitrophic marine systems (in Portugal, France and Greece) and fresh water polyculture systems (in Romania, France, Indonesia and Madagascar). These systems are divided into two modalities : 1- species reared separately in different structures permitting a precise measurement

of each species activities and role in nutrient and energy cycling, 2- Species reared all together in the same structure, showing an overall performance of species interactions. Particular attention will be paid on the primary production, as the main actor in the dissolved nutrient catching in IMTA, as a source of feed for the reared species, in a perspective of improved, and ideally total, recycling.