World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:12, No:11, 2018

Ecosystem Approach in Aquaculture: From Experimental Recirculating Multi-Trophic Aquaculture to Operational System in Marsh Ponds

Authors : R. Simide, T. Miard

Abstract : Integrated multi-trophic aquaculture (IMTA) is used to reduce waste from aquaculture and increase productivity by co-cultured species. In this study, we designed a recirculating multi-trophic aquaculture system which requires low energy consumption, low water renewal and easy-care. European seabass (Dicentrarchus labrax) were raised with co-cultured sea urchin (Paracentrotus lividus), deteritivorous polychaete fed on settled particulate matter, mussels (Mytilus galloprovincialis) used to extract suspended matters, macroalgae (Ulva sp.) used to uptake dissolved nutrients and gastropod (Phorcus turbinatus) used to clean the series of 4 tanks from fouling. Experiment was performed in triplicate during one month in autumn under an experimental greenhouse at the Institute Océanographique Paul Ricard (IOPR). Thanks to the absence of a physical filter, any pomp was needed to pressure water and the water flow was carried out by a single air-lift followed by gravity flow.Total suspended solids (TSS), biochemical oxygen demand (BOD5), turbidity, phytoplankton estimation and dissolved nutrients (ammonium NH_4, nitrite NO_2^-, nitrate NO_3^- and phosphorus PO_4^{3-}) were measured weekly while dissolved oxygen and pH were continuously recorded. Dissolved nutrients stay under the detectable threshold during the experiment. BOD5 decreased between fish and macroalgae tanks. TSS highly increased after 2 weeks and then decreased at the end of the experiment. Those results show that bioremediation can be well used for aquaculture system to keep optimum growing conditions. Fish were the only feeding species by an external product (commercial fish pellet) in the system. The others species (extractive species) were fed from waste streams from the tank above or from Ulva produced by the system for the sea urchin. In this way, between the fish aquaculture only and the addition of the extractive species, the biomass productivity increase by 5.7. In other words, the food conversion ratio dropped from 1.08 with fish only to 0.189 including all species. This experimental recirculating multi-trophic aquaculture system was efficient enough to reduce waste and increase productivity. In a second time, this technology has been reproduced at a commercial scale. The IOPR in collaboration with Les 4 Marais company run for 6 month a recirculating IMTA in 8000 m^2 of water allocate between 4 marsh ponds. A similar air-lift and gravity recirculating system was design and only one feeding species of shrimp (Palaemon sp.) was growth for 3 extractive species. Thanks to this joint work at the laboratory and commercial scales we will be able to challenge IMTA system and discuss about this sustainable aquaculture technology.

Keywords : bioremediation, integrated multi-trophic aquaculture (IMTA), laboratory and commercial scales, recirculating aquaculture, sustainable
Conference Title : ICFAM 2018 : International Conference on Fisheries and Aquaculture Management
Conference Location : Tokyo, Japan
Conference Dates : November 12-13, 2018