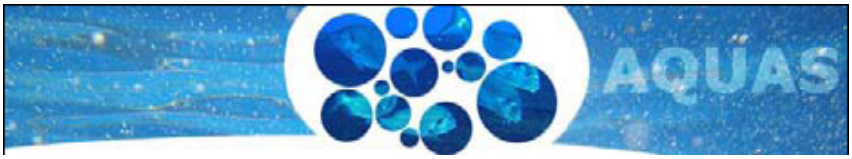

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AQUAS

Water Quality and Sustainable Aquaculture: Links and Implications

The Challenge

Over recent years there has been a steady growth in the development of aquaculture due to increased demand of cultured species for consumption. One of the by-products of aquaculture is the creation of specific environmental issues related to intensive production and unsustainable farm expansion, contributing to a certain extent to a boom and bust behaviour of aquaculture industries.
Examples are the increasing occurrence of toxic red tides and the consequent incidence of diarrhetic and paralytic shellfish poisoning in southern European countries in the early nineties, or the permanent alteration of natural habitats in Latin America. Therefore, aquaculture and local water quality (WQ) are closely linked. The large inputs of nutrients and chemicals and the release of wastes into the environment may favour toxic algae blooms and induce bottom anoxia and eutrophication, especially where the carrying capacity of the receiving domain is limited (e.g., bays and semi-enclosed water bodies). In turn, low aquaculture production rates may result from the appearance and spreading of diseases propitiated by a poor WQ.

Project Objective

AQUAS has helped to better "structure" the understanding on the relationship between aquaculture and WQ, aiming towards the establishment of a set of aquaculture-related predictors for WQ. This is the soundest way to increase farm production and product quality in a sustainable manner, i.e. within the frame of a socially acceptable Integrated Coastal Zone Management.

Key Points

- This goal has been achieved by collecting and combining existing field observations with available numerical simulations "paving" the way for quantifying the relation between WQ and farm productivity.
- This will allow the use of natural forcing mechanisms to increase or get the most out of the carrying capacity of the water body.
- The final results are a starting point towards enhanced aquaculture production without compromising the "health state" of the receiving domain for future generations.

Output Highlights

Aquaculture in Patos Lagoon estuary (Brazil) focuses on the semi-intensive cultivation of shrimps in enclosures, with a density between 20 and 30 individuals/m2, and located in 2 areas: Justino Bay and Mangueira Bay.

EATiP *Thematic Area of Relevance*

TA1: Product Quality, Consumer Safety and Health
TA2: Technology and Systems
TA3: Managing the Biological Lifecycle
TA4: Sustainable Feed Production
TA5: Integration with the Environment
TA6: Knowledge Management
TA7: Aquatic Animal Health and Welfare
TA8: Socio-Economics and Management

Key Words

Fisheries, Environmental Protection

Project Information

Contract number:
15015
Contract type:
Specific Support Action
Action line:
SUSTDEV-3.8.1 Estimating thresholds of sustainability and externalities,
SUSTDEV-3.8.2 Developing tools for integrated sustainability assessment and for the incorporation of sustainability in decision making processes
Duration:
18 months (01/01/2006 – 30/06/2007)
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Project website:
http://lim050.upc.es/aquas/

Sometimes, very high concentrations of nitrogen and phosphorus have been found due to industrial activities and the use of fertilizers in rice and soy farms. These nutrient inputs cause serious problems of eutrophication and an excessive increase in vegetal biomass in Mangueira Bay.

Starting from measurements carried out close to shrimp enclosures in Justino Bay, nutrient and dissolved oxygen results indicate that the current method of shrimp cultivation in enclosures does not significantly alter water quality.

With a fixed limit of 0.07 mg/l of TN (corresponding to the usual conditions in the Bay) a maximum of 70 enclosures (with a diameter of 32 m and a density of 20 individuals/m2) could be installed in Mangueira Bay. This would allow keeping nutrient conditions in the Bay at a level similar to the present situation.

In Valencia (Spain), there is intensive farming of gilthead seabream (Sparus aurata) and sea-bass in floating and open cages. Most of these farms are located in areas with high dilution, so no great impacts are foreseen, except in the areas located below the cages.

The two main sources of wastes generated by fish farms are the excess of food supplied that is not consumed and fish excretions. The main impacts are on the benthos below the cages. On the other hand, water quality in the area located below the cages is significantly affected by them.

The evaluation of the carrying capacity in open aquatic ecosystems (like Valencia coast) subjected to multiple sources of nutrients and pollutants is a difficult task due to the changing conditions in both hydrodynamics and water quality.
Pacific oyster culture has been introduced at San Quintín Bay (Mexico) in 1979. At present, 21 oyster companies maintain around 9,000 racks (with a commercial production of 900 T) throughout the 730 ha that have been licensed for oyster culture in the west arm of San Quintín Bay, known as Falsa Bay.

The oyster carrying capacity of Falsa Bay have been estimated in 5,974 and 1,913 T for the spring and neap tides respectively, while an average value of 3,636 T was obtained for a two-week cycle. This suggests that the production potential of the culture units installed in Falsa Bay (4,300 T) is at the limit or above the limit of the carrying capacity.

A preliminary set of sustainable management criteria have been defined for the three areas in order to develop a sustainable aquaculture.

The Full Report:
For a description of the research project, visit http://lim050.upc.es/aquas

Next Steps – Suggested Actions/Follow On

Environment

- To harmonize Environmental Surveillance Programs, since the measured parameters are not the same in different farms and most of the measured indicators are useless.
- To define the most suitable indicators in order to establish potential environmental impacts at medium and long term. In particular, some pollutants that are not taken into account (antibiotics, antifouling substances, etc.) should be controlled.

Knowledge Transfer

- To inform fish-farmers accurately and reliably about negative impacts of aquaculture on the environment, including the possibility of using operational forecasting to mitigate impacts.
- To optimize nourishment procedures in order to minimize losses of food (currently about 20%).

Policy

- To harmonize legislation at a regional level, making use of recent advances in knowledge.

Related Publications/Projects

Publications:

C. Mösso, J.P. Sierra, M. Mestres, L. Cupul, S. Falco, M. Rodilla, A. Sánchez-Arcilla & J. González del Río. The influence of topography on wind-induced hydrodynamics in Cullera Bay. Journal of Coastal Research I47: 16-29.

J.P. Sierra, C. Mösso, J. G. del Río, M. Mestres, L. Cupul, A. Sánchez-Arcilla, M. Rodilla, S. Falco, I. Romero, D. González- Marco & J. Puigdefábregas. Sources and sinks of nutrients and pollutants in Cullera Bay. Journal of Coastal Research SI47: 30-38.

S. Falco, Z. Hermosilla, I. Romero, R. Martínez, J.P. Sierra, C. Mösso & M. Mestres.Spatial and temporal patterns of water quality in Cullera Bay. Journal of Coastal Research SI47: 39-46.

L. Poersch, J. P. Castello, W. Wasielesky Jr. & R. O. Cavalli. The challenge of sustainable aquaculture: effects on the environment of the Patos lagoon estuary. Journal of Coastal Research SI47: 130-135.

P.R. Tagliani, D.M. de Freitas & M. Domingues. Conflictive uses in Mangueira Bay: a prospective analysis. Journal of Coastal Research SI47: 141-144.

Projects:

Fluxes, interactions and environment at the land-ocean boundary. Downscaling, assimilation and coupling (FIELD_AC).- Funded by EU (Programme SPACE, Ref. FP7-SPACE-2009-242284).