TOOLBOX AQUACULTURE

UNIVERSIDAD DE MURCIA

Characterization of environmental gradient in marine fish farming

SUGGESTED USERS	PLANNING PROCESS	TYPE OF AQUACULTURE
Aquaculture producers	EIA Environmental Monitoring	Marine fish pens

SUMMARY

Integration of particulate waste dispersion, physio-chemical sediment composition and biological changes along environmental gradients in marine fish farming.

DESCRIPTION

The spatial dispersion and potential effect of aquaculture particulate wastes on the ecological benthic status is site-specific and influenced by local physical-chemical and biological parameters. The characterization of environmental gradients in marine fish farming integrates particulate wastes dispersion, physio-chemical sediment composition and biological changes in the seabed.

THE ISSUE BEING ADDRESSED

The main residue derived from marine finfish farming is the organic matter released to the environment in the form of uneaten feed or fish metabolic wastes (Focardi et al. 2005). Such organic enrichment may have environmental drawbacks, especially if organic matter and nutrients surpass the threshold if their carrying capacity. Other substances derived from fish feed, even in much lower concentrations (metals, medicines, vitamins, hormones, etc.) or from other sources associated with fish farming activity (antifouling, external biocides for fish, etc.), may also have an impact on the benthic system (Olsen et al. 2008, Holmer et al. 2008). Seabed is affected depends on the type and quantity of particulate materials being released from the cage site and on the local physical conditions such as bathymetry and prevailing water currents.

This case study is currently one of the most aquaculture intensive areas in Spain of gilthead sea bream and sea bass production, with an average production of around 11.000 metric tons per year. The farming is exclusively carried out in open sea cages. The principal goal of the case study is to provide data for the validation of modelling work executed together with the sampling campaigns include in-situ measurements of a wide variety of physical, chemical and biological parameters in the environment encircling fish farms in a Fish Farming Zone.

The main objectives are to monitor:

- physio-chemical features
- toxic substances (metals and antibiotics)
- biota abundance and taxonomy (benthic micro and macro-invertebrates)
- macrofauna and phytobenthos
- sediment chemistry and composition

Samples of fauna and flora will be collected in order to investigate the nutrients kept by the encircling ecosystems with the aim to provide data for developing better environmental impact assessment models. The isotopic compositions will show not only the dispersion of nutrients from fish farm effluent but also which organism or substrate kept most of the nutrients.

THE APPROACH

Particulate waste dispersion was analyzed by measuring the POC, PON and TP sedimentation rates using sedimentation traps placed along a spatial gradient upstream and downstream of the prevailing water current, at increasing distances from the fish cages. Sampling stations were located close to the sediment traps used for measuring waste dispersion (0, 50,175 and 600 m). All distances were sampled once during the period that the sediment traps were deployed. Macrofauna was used as a surrogate of the ecological benthic status. For the macrofaunal analysis, sediment samples were washed through a 1 mm sieve with sea water. We used also chemical and biological identification of biofilm as a complementary tool. The changes in microalgae and bacterial assemblages along gradients of organic pollution on marine biofilms in the water column were also analyzed. We used microscope glass slides as the artificial surface for biofilm growth, in order to avoid confounding factors due to possible differences among

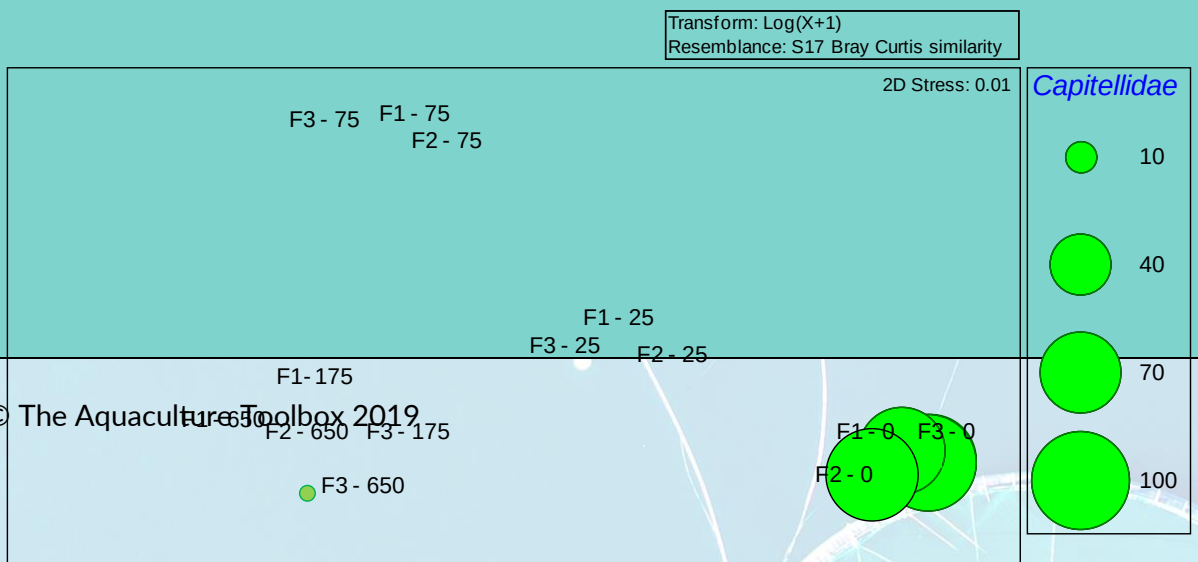
natural substrates on sampling sites. Glass slides were placed on same ropes of the sediment traps.

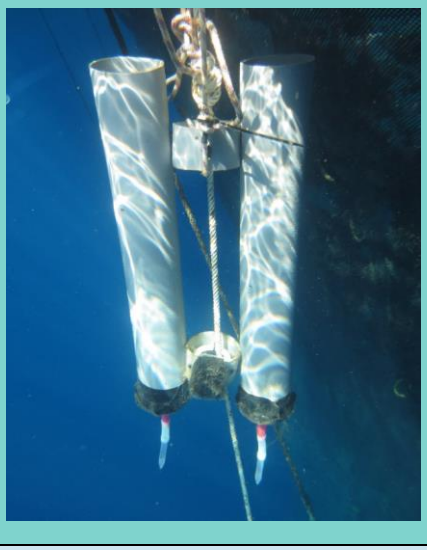
THE RESULTS

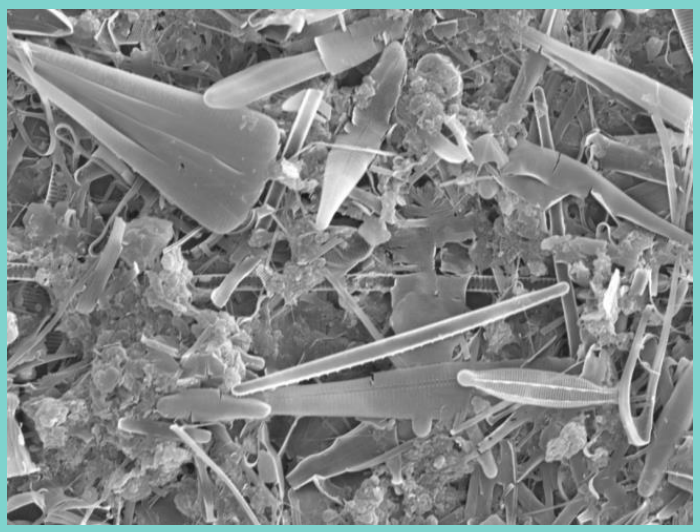
This work confirms that nutrients are reliable parameters for establishing the spatial extent of fish farm particulate wastes. Fish farming not only influences physio-chemical and biological parameters but also alters the functioning of the ecosystem from a trophic point of view, affecting. The patterns in the succession of biofilm communities are similar to sediment communities but with a quick response (15 days), which allow to predict potential impacts of different wastes deposition on benthic communities in just two weeks.

THE BROADER APPLICABILITY

This tool is easily applicable by the fish farming of the Mediterranean. This instrument provides a new approach by which producers can improve management strategies taking into account their own limitations and the environmental restrictions imposed by the regulatory authorities. Incorporating this case study in the management of an aquaculture company would be very useful in the planning and evaluation of the environmental degradation that may cause in the area that is located, or that will be located in the future. Therefore, the information obtained in this case study serves as a support in decision-making when making the timely environmental assessment of aquaculture production, helping to reduce the impact that the company in question may have on the marine environment. Likewise, with this instrument they will be able to encourage the development of better practices that lead to a better perception and image of aquaculture. Cooperate to improve management measures such as, characteristics of the feed, quantities supplied in each shot, distribution of the species grown in the polygon, consider the changes caused by the change of seasons in management practices etc.







SWOT ANALYSIS	
STRENGTHS	It couples a physical and chemical data with biological changes It Can be used to assess ecological carrying capacity. It is a management system that it can be used by regulators to environmental monitoring.
WEAKNESSES	Considerable collection and time requirement for acquisition of date for effective use.
OPPORTUNITIES	It is capable of evaluate long (month to years) and short time (days) environmental impacts of fish farming of long processes (month to years) and short time (days). It has a spatial output that can be imported into GIS.
THREATS	Requires expert knowledge.

CONTACT INFORMATION	Nuria García-Bueno and Arnaldo Marín Atucha, Department of Ecology and Hydrology, University of Murcia, Spain.
LINK	Statistical analyses are performed within the R environment (R Development Core Team, 2014), using free statistical packages available on https://www.r-project.org/