

## THE BIOFAQS PROJECT: BIO-FILTRATION AND AQUACULTURE: AN EVALUATION OF SUBSTRATE DEPLOYMENT PERFORMANCE WITHIN MARICULTURE DEVELOPMENTS

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### EDITORIAL

The use of biofiltration to improve water quality in land-based, intensive aquaculture systems where water is recycled is standard practice. However, most fin-fish mariculture is undertaken under intensive farming conditions in open cage culture in inshore coastal waters. At present, such farms are solely reliant on the local environment for waste assimilation services. The accumulation of particulate organic waste material on the seabed can have substantial effects on the biological composition of the seabed communities (Pearson & Black, 2001) and, in severe cases, impact on the health and growth of target culture species with potentially deleterious effects on the economic performance of the farm. In many countries regulations to control the scale of fish farming are based on constraining impacts on the seabed ecology and sediment biogeochemistry. There has also been considerable interest in the effects that dissolved organic and inorganic nutrients from intensive open aquaculture may have on the marine ecosystem.

A large proportion of externally supplied fish feed is lost to the marine environment as particulate organic carbon rich in nitrogen and phosphorus (Black, 2001). Given the parlous state of many of the world's fisheries, this represents a waste of valuable resources. Since ancient times practices involving the co-culture of species at different trophic levels has been used to increase the yield of agriculture and maximise the yield of edible biomass from available nutrient supplies. The world's most efficient traditional aquaculture/agriculture system was developed in China where dike-and-pond systems involving carp polyculture, sugarcane, vegetables, rice

and fruit were nourished by pig, duck, water buffalo and human manures (Smil, 2001).

Thus two possible objectives for research in the area of biofiltration and aquaculture are 1) the reduction in environmental impact by increasing the assimilative capacity of the local environment and 2) the more efficient use of nutrients to increase farm production. A third possible objective is that of increasing local biodiversity although the value of this aspect both to the ecosystem and to society is much more difficult to quantify.

BIOFAQs (BIOFiltration and Aquaculture: an Evaluation of Substrate Deployment Performance with Mariculture Developments) was funded under Framework Programme 5: Quality of Life of the European Commission.

The main initial objective related to reduction in environmental impacts with three inter-related subsidiary objectives:

1. To quantify the effectiveness of bio-filter use in association with mariculture within both economic and environmental frameworks on a pan-European scale.

2. To optimise bio-filter designs and placement protocols in line with geographical differences and validated model predictions. This objective was assessed principally through mesocosm experimentation.

3. To examine the environmental and regulatory options governing post-bio-filter usage and to provide detailed economic analyses of bio-filter use compared with existing practices.

Initial experimental work focused on the deployment of identical plastic mesh cylinders in each of 4 study sites in Scotland, Slovenia, Greece and Israel. These were moored with a high degree of replication in waters

closely adjacent to active marine fish farms and allowed to be colonized with local flora and fauna. In each country the balance between heterotrophic and autotrophic colonizers was different as was the colonizing succession and the predation or grazing response.

Removing nutrient from the fish farming system using naturally settling communities would involve not only establishing a large colonial biomass but a means of harvesting this and the production of useful products. On the basis of the experience of the initial experiments and as a consequence of discussions with the aquaculture industry, it was decided to pursue the second phase of experiments using substrates likely to be preferentially settled with a more valuable secondary harvest. For example in Scotland, ropes used for the culture of edible mussel *Mytilus edulis* were deployed. Mussels settling on these ropes demonstrated increased growth compared to mussels grown in control locations outside of the farm influence.

Economic models of secondary production both with respect to the value of reduced environmental impact

from fin-fish culture and the value of the secondary harvest have been evaluated as has the various legal and regulatory issues of biofilter deployment across a range of different jurisdictions.

At the time of writing, results from the project are still being analyzed and evaluated and several questions remain to be answered. The present volume represents a collection of some of the research that has been undertaken during the course of this work. Hopefully, it will give more than a flavour of what is to come when the project is complete and the data from across the range of sites and experiments are assimilated and synthesized. Progress of the BIOFAQs project can be monitored by reference to the project web site at [www.sams.ac.uk](http://www.sams.ac.uk).

Integrated aquaculture is an old concept currently being rejuvenated by research effort in many countries. Hopefully, the result will be in more sustainable, productive aquaculture providing crops of high nutritional value while minimizing harmful effects on the marine environment.

## PROJEKT BIOFAQ: BIOFILTRACIJA IN AKVAKULTURA

### IZVLEČEK

*Človek se z marikulturo ukvarja že od nekdaj. V novejšem času pa je pokazal precejšen interes za obsežnejše raziskave v tej obliki marikulture, in sicer z namenom, da se ugotovijo potencialne prednosti za okolje prek minimiziranja odplak, še bolj pa neposredne gospodarske koristi s proizvodnjo sekundarnih pridelkov. BIOFAQ, projekt Evropske unije, želi dognati ekološki proces koloniziranja na umetnih podlagah, razvrščenih ob ribogojnicah, poleg tega pa tudi raziskati pravne in gospodarske okvire za takšen razvoj v več evropskih jurisdikcijah. Pričujoči sklop vsebuje kratke članke, ki pojasnjujejo nekatere pomembne vidike tega projekta.*

## PROGETTO BIOFAQ: BIO-FILTRAZIONE ED ACQUACOLTURA

### SINTESI

*L'acquacoltura integrata viene praticata da tempi remoti. Di recente è aumentato considerevolmente l'interesse scientifico per tale forma di acquacoltura allo scopo di determinare, tramite la minimizzazione dei materiali di scarto, potenziali benefici all'ambiente e benefici economici derivanti dalla produzione di raccolti secondari. Il progetto EU BIOFAQ è finalizzato a determinare i processi ecologici di colonizzazione di substrati artificiali posizionati in prossimità di allevamenti di pesci e, in aggiunta, a esaminare le cornici legali ed economiche per tali tipi di interventi in diverse giurisdizioni europee. Questo volume contiene brevi articoli che sommariamente evidenziano alcuni importanti aspetti del progetto.*

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