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BIOFAQs – BIOFiltration and AQuaculture: An evaluation of substrate deployment performance with mariculture developments[1]

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SUMMARY – A significant proportion of mariculture is undertaken in Europe under intensive farming conditions in open cage culture. Wastes are dispersed from cage farms in terms of particulate organic carbon and nutrients, dissolved organic carbon and inorganic nutrients. These enrich the surrounding ecosystem and may lead to a stimulation of both primary and secondary production. This pan-European research project will demonstrate the effectiveness of reducing the environmental impacts of inputs from intensive cage mariculture by using biological filters ("biofilters"). These biofilters are being designed to offer complex surfaces for colonisation by both sessile and mobile biota, which will absorb the effluents from the fish farms and potentially increase the sustainability of coastal aquaculture. Validated model predictions will be used to assist in optimising biofilter design and placement in line with geographical differences across Europe. Environmental and regulatory options governing post-biofilter usage will also be examined and economic analyses of biofilter use compared with existing practices will be provided.

Keywords: Biofilter, Europe, aquaculture, impacts, models, sustainability, socio-economics.

RESUME – *"BIOFAQs – BIOFiltrage et AQuaculture : Une évaluation des performances du substrat déployé selon les développements de la mariculture". Une proportion significative de la mariculture est faite en Europe en conditions d'élevage intensif en systèmes ouverts de cages. Les rejets sont dispersés à partir des exploitations en cages en termes de carbone organique particulé et nutriments, carbone organique dissous et nutriments inorganiques. Ils enrichissent l'écosystème environnant et peuvent mener à une stimulation de la production primaire et secondaire. Ce projet de recherche pan-européen démontrera qu'il est possible de réduire les impacts environnementaux des intrants de la mariculture intensive en cages en utilisant des filtres biologiques ("biofiltres"). Ces biofiltres sont conçus pour présenter des surfaces complexes à la colonisation par les biotes aussi bien sessiles que mobiles, qui absorberont les effluents des fermes piscicoles et pourront augmenter la durabilité de l'aquaculture littorale. Des prédictions de modèles validés seront utilisées pour aider à optimiser la conception des biofiltres et l'emplacement aligné selon différents points géographiques à travers l'Europe. Les options environnementales et régulatrices applicables à l'utilisation des biofiltres seront également examinées et l'utilisation de biofiltres sera analysée économiquement en comparaison avec les pratiques existantes.*

Mots-clés : *Biofiltres, Europe, aquaculture, impacts, modèles, durabilité, socio-économie.*

Introduction

Finfish farming is dominated in north European waters by the culture of Atlantic salmon (*Salmo salar*) and in southern Europe by sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*). In both areas several new species are being developed. A significant proportion of mariculture is undertaken under intensive farming conditions in open cage culture. Wastes are dispersed from cage farms in terms of

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particulate organic carbon and nutrients, dissolved organic carbon and nutrients and inorganic nutrients. These enrich the surrounding ecosystem and may lead to a stimulation of both primary and secondary production (reviewed by Pearson and Black, 2001).

This research project will demonstrate the effectiveness of reducing the environmental impacts of inputs from intensive cage mariculture by using biofilter deployments. Biofilters are being designed to offer complex surfaces for colonisation by both sessile and mobile biota with a variety of feeding modes. By absorbing effluents from fish farms, biofilters can potentially add to the sustainability of coastal aquaculture (reviewed by Black, 2001) provided that they allow for the removal of nutrients from the system. They may also increase diversity by providing niches and refuges otherwise unavailable.

Objectives

The project has three inter-related principal objectives:

(i) To quantify the effectiveness of biofilter use in association with mariculture within both economic and environmental frameworks on a pan-European scale.

(ii) To optimise biofilter designs and placement protocols in line with geographical differences and validated model predictions. This objective will be assessed principally through mesocosm experimentation on filter units brought from the field.

(iii) To examine the environmental and regulatory options governing post-biofilter usage and to provide economic analyses of biofilter use compared with existing practices.

Workpackages

These objectives are addressed through 6 workpackages (WP):

(i) WP1. To review existing biofiltration methodology. From this review will come a synthesis of current biofiltration techniques and how they may be adapted for European open-system mariculture industries.

(ii) WP2. To advance existing fish farm impact/dispersal models to predict the performance of biofiltration deployments by the addition of biogeochemical modules specific to the function of biofilters and their potential ability to increase remineralisation rate and trap nutrients. Field validation of predictive environmental impact models will be undertaken to further develop and validate models that can predict the economic and environmental benefits of biofilter deployments in association with mariculture development.

(iii) WP3. To undertake a programme of mesocosm experiments that will assess biofilter design and performance over a range of temporal scales, a range of environmentally relevant physico-chemical parameter variations and under differing loading rates. The full assessment of performance will incorporate determinations of energy and nutrient fluxes, examination of fallowing dynamics and investigation of biofilter design with specific reference to determining surface area availability requirements.

(iv) WP4. An extensive fieldwork programme will be undertaken using test biofilter deployments in association with ongoing mariculture concerns. The fieldwork programme will yield data that will be employed to verify the results from the mesocosm and modelling work packages.

(v) WP5. To review the current regulatory status of mariculture impacts and hard substrate deployments in European waters and to ascertain the likely acceptance of biofilters within these regulatory frameworks.

(vi) WP6. To prepare pan-European cost/benefit analyses of biofilter deployment in association with mariculture development with specific reference to environmental value.

Methodologies

Although the project was inspired by previous developments of a benthic biofilter near a fish farm in Eilat, Israel, initial experiments will concentrate on the use of moored structures as these will be easier to remove from the system for mesocosm experiments. During the first full year of the project, biofiltration structures made up of a range of monometric components to facilitate replication are being deployed at farms in the west of Scotland, in Slovenia, in Crete and in Israel. In subsequent years biofilter design may be changed in the light of experience gained during year 1 and it is likely that some experimentation will be done with benthic structures.

The project will be truly multidisciplinary involving physics, biogeochemistry, chemistry, ecology, law and socio-economics.

References

Black, K.D. (2001). Sustainability of Aquaculture. In: *Environmental Impacts of Aquaculture,* Black, K.D. (ed.). Sheffield Academic Press, Sheffield, pp. 199-212.

Pearson, T.H. and Black, K.D. (2001). The environmental impact of marine fish cage culture. In: *Environmental Impacts of Aquaculture,* Black, K.D. (ed.). Sheffield Academic Press, Sheffield, pp. 1-31.