**Amsterdam Meeting - Biofaqs Summary (30.1.03)**

Present: Dror A., Kenny B., Martin S., Manolis T., Tina V., Sonja L., Hannah W., Ehud S., Ken C., David W. & Prem Wattage

Chair: Kenny Black

Minutes taken by Liz Cook

**Biofaqs Annual Report**

All partners to check their sections and the summary in the annual report by 4 Feb 2003. All changes/ comments to be sent to Kenny BUT partners must NOT alter text on main document. Fig. and table numbers will be added separately.

Non-confidential summary – Kenny to write a summary of Years 1 & 2 for this section.

Presentation of Main Findings (2002)

**Ehud Spanier**

Biomass greater fish farm compared to control.
Certain organisms known to feed on zooplankton
Grazing: Reduction in grazing around fish farm. Transplantation of biofilters between study sites? Stable isotope – high intake of fish farm waste from fish farm.

Wild fish – extent of grazing unknown. Dominant species Rabbitfish. Study planned to examine grazing on Ulva by wild fish populations at fish farm and control site. Harvesting of wild fish or invertebrate grazers (e.g. sea urchins) could be means of removing organic input from farm.

Mussel Lines – Similar composition of biofouling organisms to the mesh cylinders. Increased algae (Jania sp.) at fish farm compared to control.

Future – Planning to survey several natural and artificial substrates, concentrating on 4 major taxonomic groups. Identify other areas where biofilters could be used to reduce inorganic input (e.g. sewage outfalls etc.).
Continue with growth of pearl oyster (Pinctada sp.) in port of Ashdod under fish farm and processing of samples for stable isotope.

Questions:

Timing of biofilter deployment – First recruits can determine the future community structure.
Biofilter material – Mesh vs mussel rope vs Hawaiian Skirt!
Utilisation of biofouling organisms – food, biotech industry, environmental value (transplantation of corals to repair reefs impacted by tourism, construction etc., sale of certain fish species for ornamental fish industry).
Influence of wild fish on uptake of particulate waste – contribution of these fish to the total biofiltration capability of the farm.

**Tina - Piran**

Repeat mesocosm expt. (March 2003).
Growth commercial algae at fish farm and measure uptake of dissolved nutrients.

**Manolis - Crete**

Clear succession of fouling material on filters. After 4 – 6 months see a significant increase in biomass (as in Oban).
In situ mesocosm work (8-10 litres/ min recycled). Incubation time – 4-6 hrs. Nutrients, chl a, POC, PON, bacteria etc. – samples removed every hour.
Oxygen – Increase in daylight, decrease at night.
Ammonium – Decrease during day, increase at night.
Phosphate – Greater increase during night compared with day.
Oxygen uptake correlated with temperature.
Solar irradiation correlated with ammonium flux (2 month biofilter – dominance of macroalgae).
Future plans
Concentrate on macroalgae, as nutrient release considered to be main problem. Seeding of lines with macroalgae common and techniques could be used on farm.
Concentrate on reducing nutrients released into environment around fish farm.

**Hannah (CEMARE) – Legal Issues**

Slovenia – No results from Slovenia. Problems with receiving documentation.
Legal implications – Differences between countries.
Motivation for use – biofilters viewed more favourably if described as mitigating environmental impact. If used for commercial purposes – require additional permits/ will be additional constraints.
Require species lists (**Action: All partners**).
No real problems, can all be overcome by management procedures.
Different legal issues between culture and wild harvest of mussels.
**ACTION**: Require copies of 'Actual' permits for current farm sites in each partner country.
Israel – known as the Business Licence (**ACTION: Dror to contact Timor**)

**David (CEMARE) – Cost-Benefit Analysis**

Benefits – Installation of bio-filter enables maintenance or increase of production or reduction of environmental impact.
Improved water quality – typically measured in terms of nitrates and phosphates.
'With' or 'Without' Biofilter relationship – Reduction of pollution or increase in production – depends on what 'Society' wants...
Folke et al. – Economic value placed on damage caused by environmental pollution.
Easier to place value on increase in salmon production rather than improvement in environmental quality.
Chopin et al. 2001 – Salmon and Gracilaria production. Salmon farm – increase in size then increase profitability. BUT if include environmental costs will significantly reduce the profitability of the farm. Environmental costs – taken from Folke et al. – whole argument based on validity of these costs – problems due to differences between sites/ countries. Used the commercial value of Gracilaria – increased profitability of farm.
What would happen if effluent charges are introduced to salmon farms? What would these implications be? Would use of bio-filters reduce the effluent charges? Need to look at sensitivity of sites. Beneficial effect of moving farms to less sensitive areas.
**ACTION**: **Send costing of setting up a mussel farm and scale of farm related to environmental impact. Impact of mussel farm on salmon farm – costs (e.g. reduction in water flow/ impact on salmon production)?**

Sonja – IJS

Particulate material – Predominantly faecal material intersecting the biofilters. Need to send fresh stripped faecal material and material from sediment traps. Mussel (5 – 13% of material derived from fish farm). Tunicates (5 % cage derived material-Eilat; 20% Oban).

Samples need to be sent by the beginning of March 2003.

Ingrid – IOLR

**ACTION**: Dror to circulate Ingrid's address. Need to determine whether Ingrid is still able to analyse samples.

**Discussion of Conclusions**

Uses for Bio-filters

1. Conservation & Biodiversity
2. Removal of Dissolved Nutrients
3. Removal of Particulates

Behaviour of bio-filters

1. Region Specific/ Commercialisation:
    a. Eilat – Predominately dissolved nutrient removal/ increase coral & fish diversity
    b. Oban – Less impact of dissolved nutrients from the fish farm, particularly in well-flushed areas. Greater relevance is particulates – production levels are determined by footprint of particulates around farm. Allowable zone of effect. Potential polyculture of macroalgae and bivlaves. Use of biofiltration as an alternative income source.
    c. Crete – Predominantly dissolved nutrients. Potential polyculture of macroalgae.
    d. Piran – Predominant particulates. Potential polyculture with mussels (?).

Economics

Much wider range of environmental benefits than first thought. Benefits of the biofilter felt by fish farm (additional crop) and/ or general society. Project should enable clarification of who actually benefits from biofiltration around the farm.

Question: Incentive to install biofilters, depends on policy/ regulatory framework.

**Project – Concept of mitigating fish farm impacts**

- Eilat – Use of macroalgal filters (but problem with measuring grazing rates). Long term monitoring of water quality. Need more focused research on uptake of particulate material by particular species growing on the biofilters and then to identify if they have an economic value (biotechnology).
- Crete – As in Manolis – Crete section
- Oban – Use of deeper filters/ long term monitoring of water quality.

Potential to change to more profitable species, would be economically viable to employ mititgation strategies. But with species such as salmon, where profits are so low need to be able to produce additional income from biofiltration technique.

Ken C. – Wide dispersal of organic outputs from cages at sea. Inland – dealing with effluents from pond culture much easier.
Particulates – value in trying to concentrate particulates at bottom of cage. Problem with disposal of waste (on land) and decomposition of particulates (release of sulphur). Need to address the interception rate (~10 %) of particulate waste by biofilters! Would it be more sensible to reduce the stocking density of farm.
Yaki (Baltic) and contact in Ukraine (highly polluted waters) – potential to use artifical structures to clean up coastal waters. Need to look at a wider scale – for the public good...applies directly to shellfish cultivation – will reduce the nutrient/ phytoplankton content of the water.

David
1. Biofilter – what are they, how do they work, how can they mitigate pollution from aquaculture (BIOFAQs)
2. Start with defined problem, pollution from aquaculture – look at all the options, decline in profitability – use of polyculture.

Problem has been defined in terms of human waste, agricultural runoff, so have decided that would be a cost to release of waste by aquaculture. EU – not quite sure what impacts are but there must be a cost to the release of this waste. Need to address the severity of problem. Public perception of fish farming – society has problem with release of waste. Issue not necessarily with how much waste is removed, other issues such as increase in biodiversity may also be considered an additional issue.

Biodiversity Issue – Relates to economic evaluation. Funding available for biodiversity studies. Difficult to quantify. Artificial reefs under fish farm compared to control site. Production vs attraction debate. Creation of nursery grounds/ sanctuaries.

Global perspective – creating artificial reef habitat, extending value of rocky shores further offshore where seabed typically featureless (reduction in niches). Fish farm source of organic material to enrich the artificial reef. Reef habitat has long term value (permanent increase in biodiversity), requires no maintenance, use of fish farm as organic fertiliser and reef has numerous benefits – nursery grounds, increased biodiversity, increase in abundance of commercial fish species etc. Main problem is with the deployment (legal issues).

Commercial Issue – Use of biological filters/ artificial reefs to encourage growth of commercial species/ ornamental species.

## Action Points (Eilat Meeting)

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| OBAN | 1. Mussel line work to continue until June 2003.<br>2. Fatty Acid analyses of Oban bivalves, but also a request for samples of bivalves from other partners – Liz to co-ordinate.<br>4. With intensive fieldwork survey and include expt. With dialysis bags (repeat as in Crete).<br>5. Samples to Sonja and Ingrid (?) – Including stripped faeces.<br>6. Write papers<br>7. Look at bioaccumulation of metals and chemicals in bivalves at control and fish farm<br>8. Compile data availability tables for all partners. |
| EILAT | 1. To maintain filters and filter lines<br>2. To undertake dynamic measurements of the uptake of particulates (possibly in mesocosm-type experiments). Results available in next 2 months. Flow cytometry data (Dror)<br>3. Determination of DOM dynamics through bioassay deployment - Possibility of expt. Involving dialysis bags.<br>4. Possible assessment of the biofiltration potential of maintaining partially fouled cage nets. Timor to discuss with farm – use of cage netting as biofilter. Use of untreated netting. Nets changed more frequently. Change in net management. Dependent on agreement by fish farm.<br>5. Macroalgae biofilters (small scale) – start in spring 2003. |
| PIRAN | 1. To repeat their previous studies in Spring 2003.<br>2. To examine the potential for incorporating macroalgal culture into the biofilter design.<br>3. Write papers |
| CRETE | 1. To undertake a series of bioassay experiments to quantify the impact of the farms at different depths and distances and at different times of the year. February – start first expt. July/ Aug – second expt. Bioassay at different distances and depths. |
| HAIFA | 1. To examine the possibility of swapping fish farm and control biofilters in order to assess grazing pressures<br>2. Algae expt.<br>3. Mussel line sampling<br>4. Survey of 4 major taxonomic groups on other natural and artificial substrates in Gulf of Eilat<br>5. Samples to Sonja for stable isotope.<br>6. Quantify and identify corals growing around the farm, particularly growth rates.<br>7. Ashdod – Survival and growth at fish farm and 2 control areas of bivalves. |
| SOUTHAMPTON | 1. Oxygen uptake of Eilat biofilters in Jan 2003 - Delay until later in the year.<br>2. Oxygen uptake of Piran biofilters in April/May 2003<br>3. Data collection from Crete. |

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| CEMARE | 1. Economic analysis to be undertaken – on-going<br>2. David W to liaise with Kenny B to establish what is required to fully undertake the economic analysis (information from SEPA, EQS information etc.) - Collaboration with Kenny and Liz – Production of paper. Send list of requirements for analysis to Dror to compile for Canada. |
| SONJA | 1. Request for a lot more samples from other partners<br>2. Faeces and animal samples as soon as possible.<br>- faeces stripped from 3 fish, allow to stand for 24h in seawater then filtered<br>- sediment trap samples from traps placed after the last feed on day 1 and recovered before first feed on day 2<br>- then sent to Sonja as soon as possible<br>3. Specific request for species from Crete as found on the biofilters but collected from another location. |
| BIOFILTER GROUPS (Oban, Crete, Piran, Eilat) | 1. To provide basic physico-chemical background data for all four study sites – Kenny Black to provide proforma, circulate and collate returns.<br>2. To provide faeces/sediment material for Sonja (see above)<br>3. To provide material for proximate analysis (Ingrid @ Eilat)<br>- sample fouling communities from farm and control sites after 3-4 months of exposure<br>- dry to 45ºC or freeze dry<br>- about 20g of material required for each sample |
| DROR | 1. To begin first draft of project conclusions. |

**Technical Implementation Plan (TIP)**

Contractual Document – Final project payment dependent of the submission of the TIP wthin 2 months of the end of the project.

SAMS will do most of TIP for Biofaqs.
Part 1: Overview (Press release type document). Written in journalistic style.
Need to identify which partner owns which results.
Part 2: Partner involvement. Require description of intention by each partner. Can be submitted independently from the consortium.
Part 3: Search for collaborations.
Part 4: Assessment of European Interest – based on community added value and social objectives.

Writing the TIP

TIP initiation on EU website
**Action: SAMS to prepare 1st draft in next couple of months for circulation around partners.**
Piran and IJS – Combined submission to TIP.

**Potential Publications**

1. Succession Paper – Pan –European (Liz)

2. Literature Review – 1. Filtration in marine organisms. 2. Biofiltration (Applied)
3. Mesocosm Expts/ Modelling (Liz & Chris + others?)
4. Intensive survey/ Vertical filter biofouling (Liz & Chris)
5. Mussel lines – Growth rates of bivalves.
6. Caprellid study (Short communication)
7. Fatty acid paper (Liz)
8. Stable isotope for all sites (Sonja + others)
9. Biofouling succession & biomass in Eilat (Anat, Ehud + others)
10. Biofilters and environmental parameters (Timor + Ehud)
11. Mussel rope survey
12. Grazing in Eilat (short communication) – (Ehud)
13. Ashdod – monoculture work
14. Practical approaches to biofiltration (overview) (Dror)
15. Microcosm Expts – Filtration rates (Timor + Dror)
16. Mesocosm Expts – 24 hr (Tina and Alenka)
17. Biofouling/ succession (Thesis) – Alenka + student
18. Land based mesocosm – mass balance (N+P) - Manolis
19. In situ mesocosm and biofiltration - Manolis
20. Succession on biofilters – Manolis
21. Application of legal analysis to marine aquaculture – Helen & Hannah
22. Legal possibilities for the deployment of biofilters – Helen & Hannah
23. Economic appraisal based on specific system (ie. Salmon and mussels) – David (J. Ecological Economics/ Aquatic Living resources?)
24. Policy and Management – Discussing relevance of biofilters (J. Marine Policy)
25. Popular type of article - J. European Environment
26. Oxygen consumption as measure of Carbon flow (Ken C.). Hard substrate community C budgets.
27. Synthesis Paper (Kenny!)

Popular articles

Aquaculture International
Fish Farming News

** Monthly report – need to inform other partners about which journal

**Final Biofaqs Report**

31 November – Submission of 3rd year report.
31 January – Submission of Final Report.

Next meeting – Discuss with Yannis

Time Allocation – All partners must look carefully at time allocations for each section for each workpackage.

Extension: Discussion about extension to project. Partners to include a short paragraph in specific sections intimating that may need an extension.