Establishment of blue mussel beds to enhance fish habitats

Human activity has impacted many coastal fjords causing degeneration of the structure and function of the fish habitats. In Nørrefjord, Denmark, local fishermen complained of declining fish catches which could be attributed to eutrophication and extraction of sediments over several decades. This study aimed to establish blue mussel beds (Mytilus edulis) to increase structural complexity and increase the abundance of fish and epifauna in Nørrefjord. It was expected that the mussels would improve water transparency and increase the depth range and coverage of eelgrass (Zostera marina). New methods for mussel production and -bed construction were investigated in collaboration with local volunteer fishermen. The effect of the artificial mussel beds was most evident on a small scale. Video observations directly at the beds (Impact area) demonstrated increased biodiversity and a three times higher abundance of mesopredator fish compared to the Control area. Water clarity and eelgrass coverage were unchanged. Two methods for establishing mussel beds were tested. A total of 44 tons of blue mussels were produced and established in beds over an area of 121,000 m². Production of blue mussels directly on hemp sacs hanging on long-lines was the most effective method. This new method is potentially a useful management tool to improve fish habitats.
Growth and respiration in blue mussels (Mytilus spp.) from different salinity regimes

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Growth potential of blue mussels (M. edulis) exposed to different salinities evaluated by a Dynamic Energy Budget model

For bluemussels, Mytilus edulis, one major constrain in the Baltic Sea is the low salinities that reduce the efficiency of mussel production. However, the effects of living in low and variable salinity regimes are rarely considered in models describing mussel growth. The aim of the present study was to incorporate the effects of low salinity into an eco-physiological model of blue mussels and to identify areas suitable for mussel production. A Dynamic Energy Budget (DEB) model was modified with respect to i) the morphological parameters (DW/WW-ratio, shape factor), ii) change in ingestion rate and iii) metabolic costs due to osmoregulation in different salinity environments. The modified DEB model was validated with experimental data from different locations in the Western Baltic Sea (including the Limfjorden) with salinities varying from 8.5 to 29.9 psu. The identified areas suitable for mussel
production in the Baltic Sea are located in the Little Belt area, the Great Belt, the southern Kattegat and the Limfjorden according to the prevailing salinity regimes. The new model can be used for supporting site selection of new mussel nutrient extraction cultures in the Baltic Sea that suffers from high eutrophication symptoms or as part of integrated multi-trophic aquaculture production. The model can also be used to predict the effects of salinity changes on mussel populations e.g. in climate change studies.

**General information**
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- **Authors:** Maar, M. (Ekstern), Saurel, C. (Intern), Landes, A. (Intern), Dolmer, P. (Ekstern), Petersen, J. K. (Intern)
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Acidification and warming affect both a calcifying predator and prey, but not their interaction: Feature article

Both ocean warming and acidification have been demonstrated to affect the growth, performance and reproductive success of calcifying invertebrates. However, relatively little is known regarding how such environmental change may affect interspecific interactions. We separately treated green crabs Carcinus maenas and periwinkles Littorina littorea under conditions that mimicked either ambient conditions (control) or warming and acidification, both separately and in combination, for 5 mo. After 5 mo, the predators, prey and predator-prey interactions were screened for changes in response to environmental change. Acidification negatively affected the closer-muscle length of the crusher chela and correspondingly the claw-strength increment in C. maenas. The effects of warming and/or acidification on L. littorea were less consistent but indicated weaker shells in response to acidification. On the community level, however, we found no evidence that predator-prey interactions will change in the future. Further experiments exploring the impacts of warming and acidification on key ecological interactions are needed instead of basing predictions of ecosystem change solely on species-specific responses to environmental change.
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Epifyt og epifauna på ælegræs (Zostera marina) i Nørrefjord, Faaborg

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Authors: Thorsen, S. W. (Ekstern), Knudsen, M. (Ekstern), Poulsen, L. K. (Intern), Kristensen, L. (Intern), Dolmer, P. (Intern), Stenberg, C. (Intern), Landes, A. (Intern), Støttrup, J. (Intern), Holmer, M. (Ekstern)
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Etablering af biogene rev - en vej til nyt liv i danske fjorde?

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Authors: Poulsen, L. K. (Intern), Stenberg, C. (Intern), Dolmer, P. (Intern), Kristensen, L. (Intern), Aabrink, M. (Intern), Christensen, H. T. (Intern), Holmer, M. (Ekstern), Thorsen, S. W. (Ekstern), Knudsen, M. (Ekstern), Oelschlägel, A. (Intern), Støttrup, J. (Intern)
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Projects:

Mussel growth and filtration in relation to salinity and food conditions

National Institute of Aquatic Resources
Period: 15/07/2010 → 30/11/2015
Number of participants: 4
Phd Student:
Landes, Anja (Intern)
Supervisor:
Dolmer, Per (Intern)
Poulsen, Louise K. (Intern)
Main Supervisor:
Production of mussels: Mitigation and feed for husbandry (MUMIHIUS) (38790)

The concept of MuMiHus was to develop and document mussel farming as a means of mitigating effects of eutrophication of the coastal zone. Specific objectives of the project were i) to adapt known mussel farming techniques to production of maximal biomass at lowest possible costs; ii) to assess environmental impact of blue mussel extraction culture with special focus on benthic effects; iii) to integrate the results in an ecosystem based management model in order to make an overall assessment of environmental impact; iv) to assess effects of low salinity and cyanobacteria occurrence on growth of blue mussels through bioenergetic studies; v) to develop management tools for and economic analysis of extraction cultures as a mitigation measure; vii) to assess bioaccumulation of contaminants in blue mussels as a prerequisite for future use of mussels as feed in husbandry.

MuMiHus demonstrated that mussel farming may be an efficient means of mitigation in terms area efficiency and it was shown that more biomass could have been produced per area unit. Environmental impact studies and modelling showed that in highly eutrophic areas like Skive Fjord, negative environmental impact of mussel farming on the benthic environment are difficult to detect due to the already high organic loading to the sediment. It was further demonstrated that mussel farming might have a relatively higher effect on environmental quality indicators like water transparency compared to load reduction. Based on physiological studies and assessment of environmental conditions a number of coastal areas in Danish waters were appointed as suited for mitigation culture of mussels. Costs of nutrient removal through mussel farming were calculated and cost effectiveness of mussel farming was shown to be compatible to most of the remaining available land based abatement measures. Concentration of hazardous substances in the mussels was shown not to be in conflict with use of the produced mussels for feed or human consumption.

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National Institute of Aquatic Resources
Danish Shellfish Centre
Danish Shellfish Centre
Aarhus University
University of Southern Denmark
Bolding Burchard Hydrodynamics
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Research areas: Shellfish and seaweed & Coastal Ecology
Project participant:
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Poulsen, Louise K. (Intern)
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Landes, Anja (Intern)
Project Manager, academic:
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Project Coordinator:
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