# Current Experiences with Mussel Mitigation Cultures

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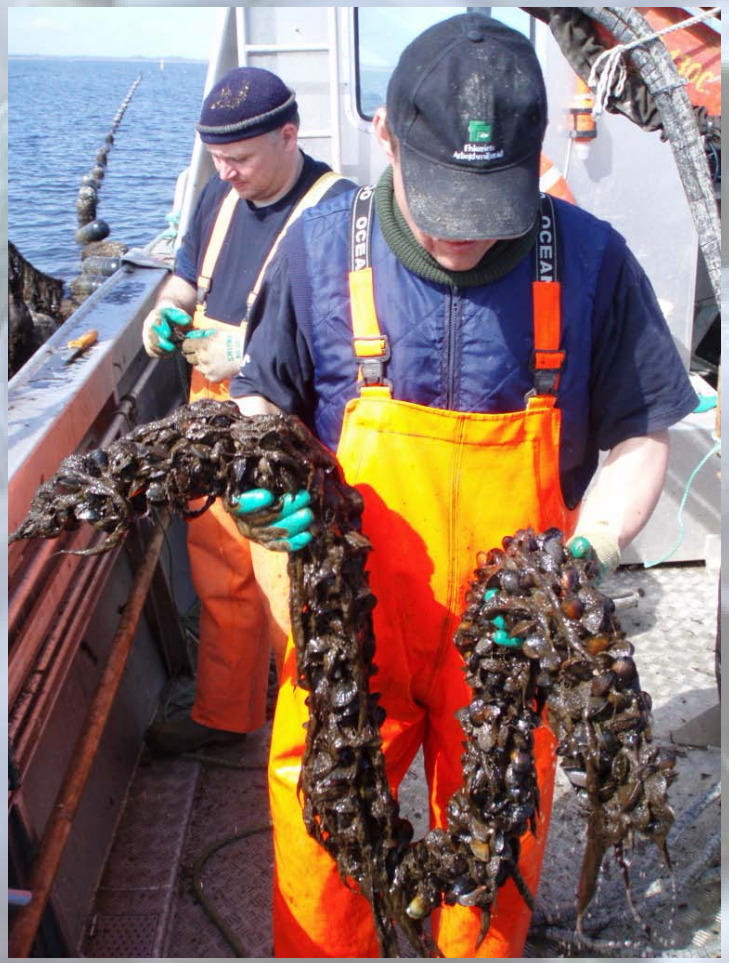
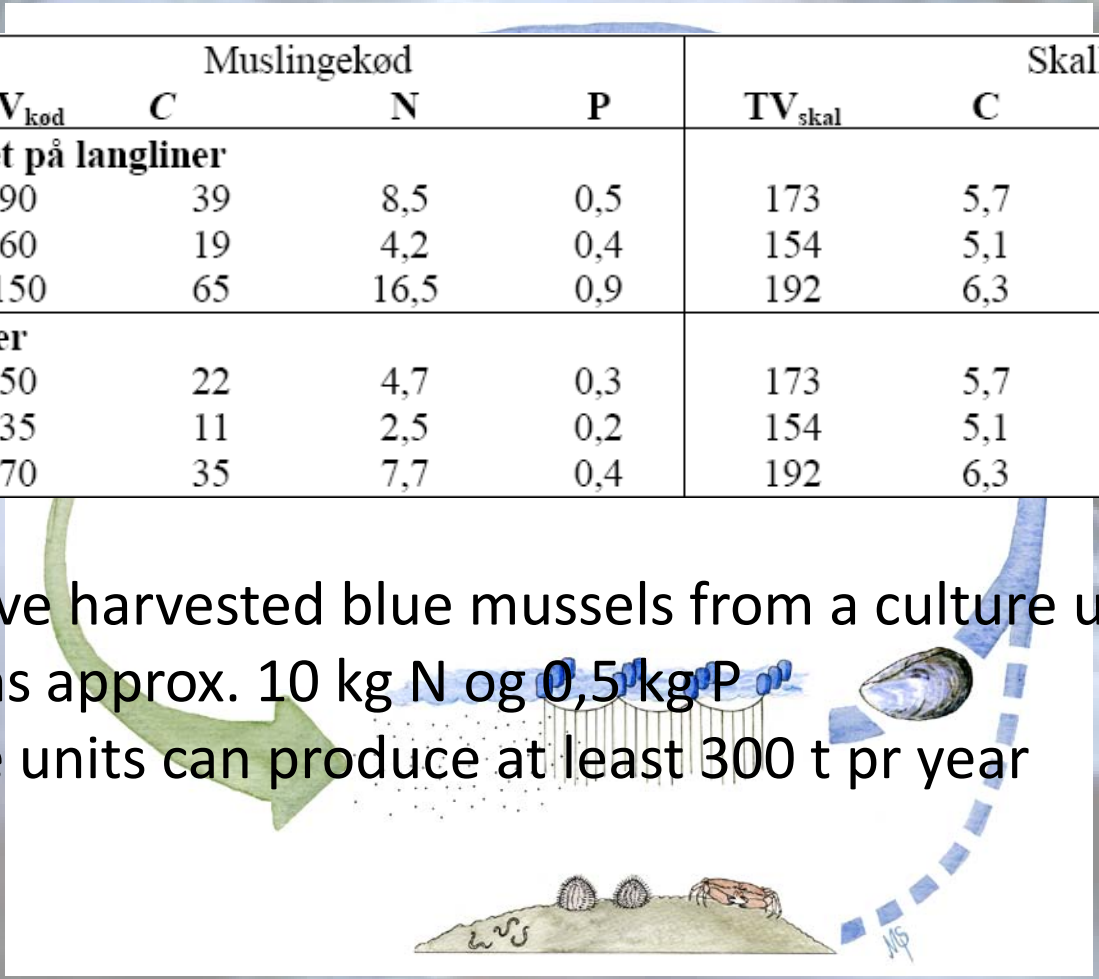
# Blue mussels are basically food



# But mussels can be more than food

| | Muslingekød | | | | Skaller | | | |
|---|---|---|---|---|---|---|---|---|
| | $TV_{kød}$ | *C* | N | P | $TV_{skal}$ | C | N | P |
| **Muslinger dyrket på langliner** | | | | | | | | |
| Estimat | 90 | 39 | 8,5 | 0,5 | 173 | 5,7 | 1,7 | 0,1 |
| Min. | 60 | 19 | 4,2 | 0,4 | 154 | 5,1 | 1,5 | 0,1 |
| Max. | 150 | 65 | 16,5 | 0,9 | 192 | 6,3 | 1,9 | 0,1 |
| **Fiskede muslinger** | | | | | | | | |
| Estimat | 50 | 22 | 4,7 | 0,3 | 173 | 5,7 | 1,7 | 0,1 |
| Min. | 35 | 11 | 2,5 | 0,2 | 154 | 5,1 | 1,5 | 0,1 |
| Max. | 70 | 35 | 7,7 | 0,4 | 192 | 6,3 | 1,9 | 0,1 |

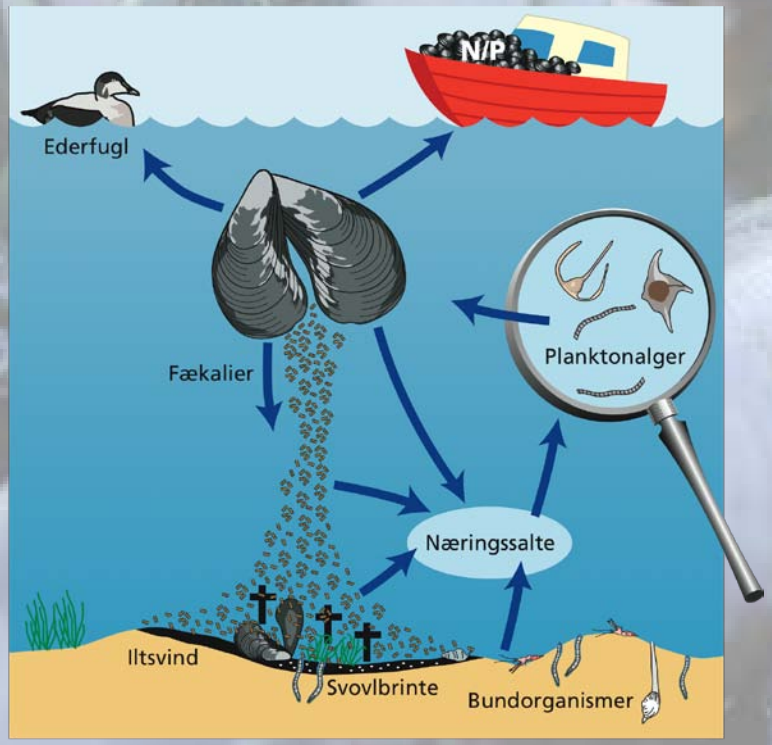


- 1 t of live harvested blue mussels from a culture unit contains approx. 10 kg N og 0,5 kg P
  Culture units can produce at least 300 t pr year

# Mussel mitigation production

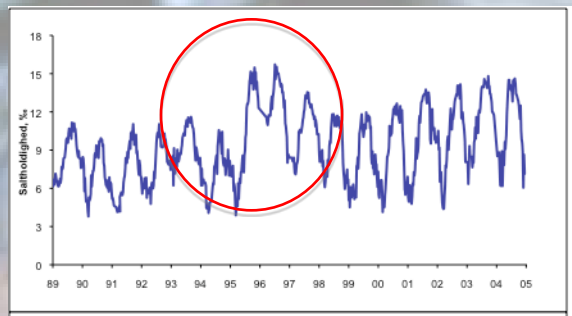
- Assuming removal of approx. 10 kg N and 0,5 kg P per tonnes live mussels; and
- Expecting a mitigation production of 800-1200 t mussels per standard culture unit
- This can be translated into actual no. units in Danish estuaries according to reduction requirements:
    - Skive, Lovns, Risgaarde: 34 units (339 t N)
    - Ringkøbing Fjord: 61 units (610 t N)
    - Roskilde fjord + Isefjord: 23 units (234 t N)
    - Limfjorden:  377 units (3770 t N)

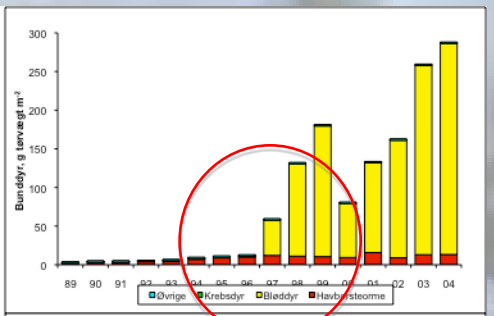
# Green mussels

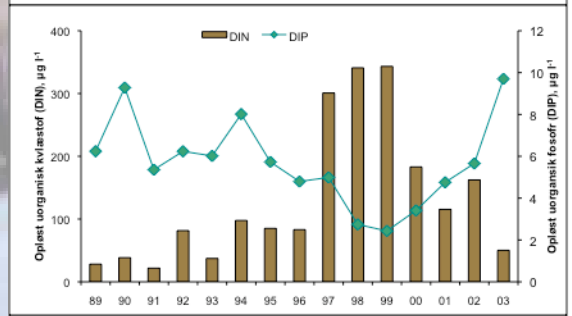


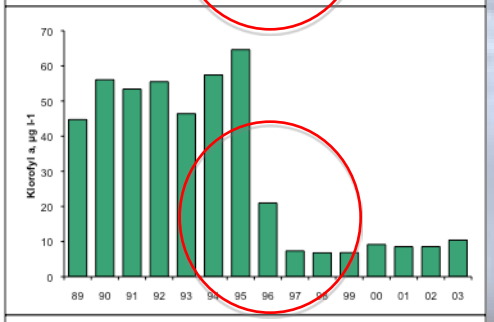

- Positive impact:
  - Removal of nutrients
  - ”Ringkøbing” syndrome
  - Reef effect
- Negative impact:
  - Increased sedimentation below culture units
  - Food web interaction
  - Visual pollution

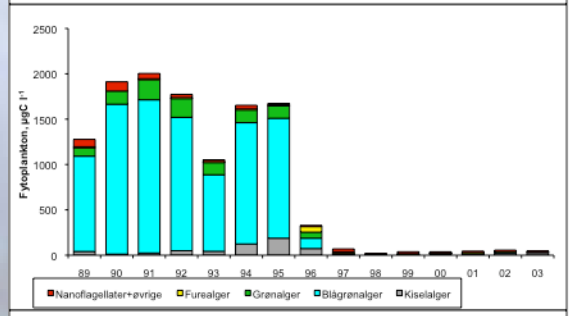
# ”Ringkøbing syndrome”

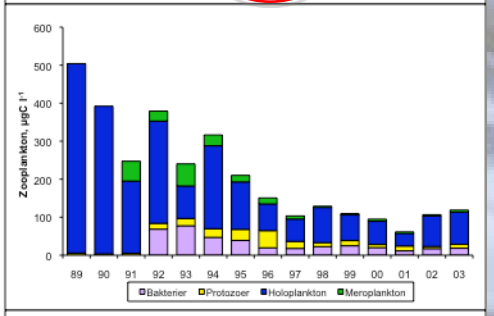


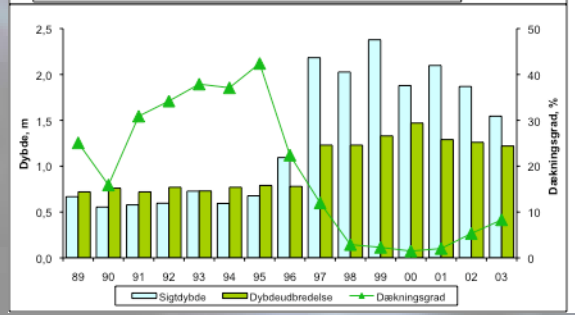



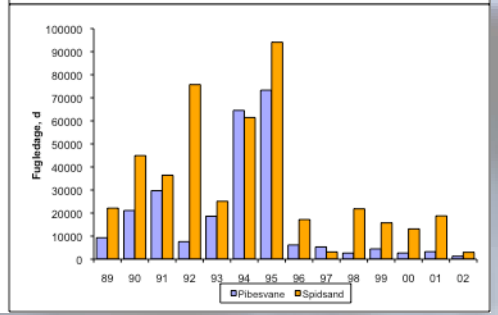



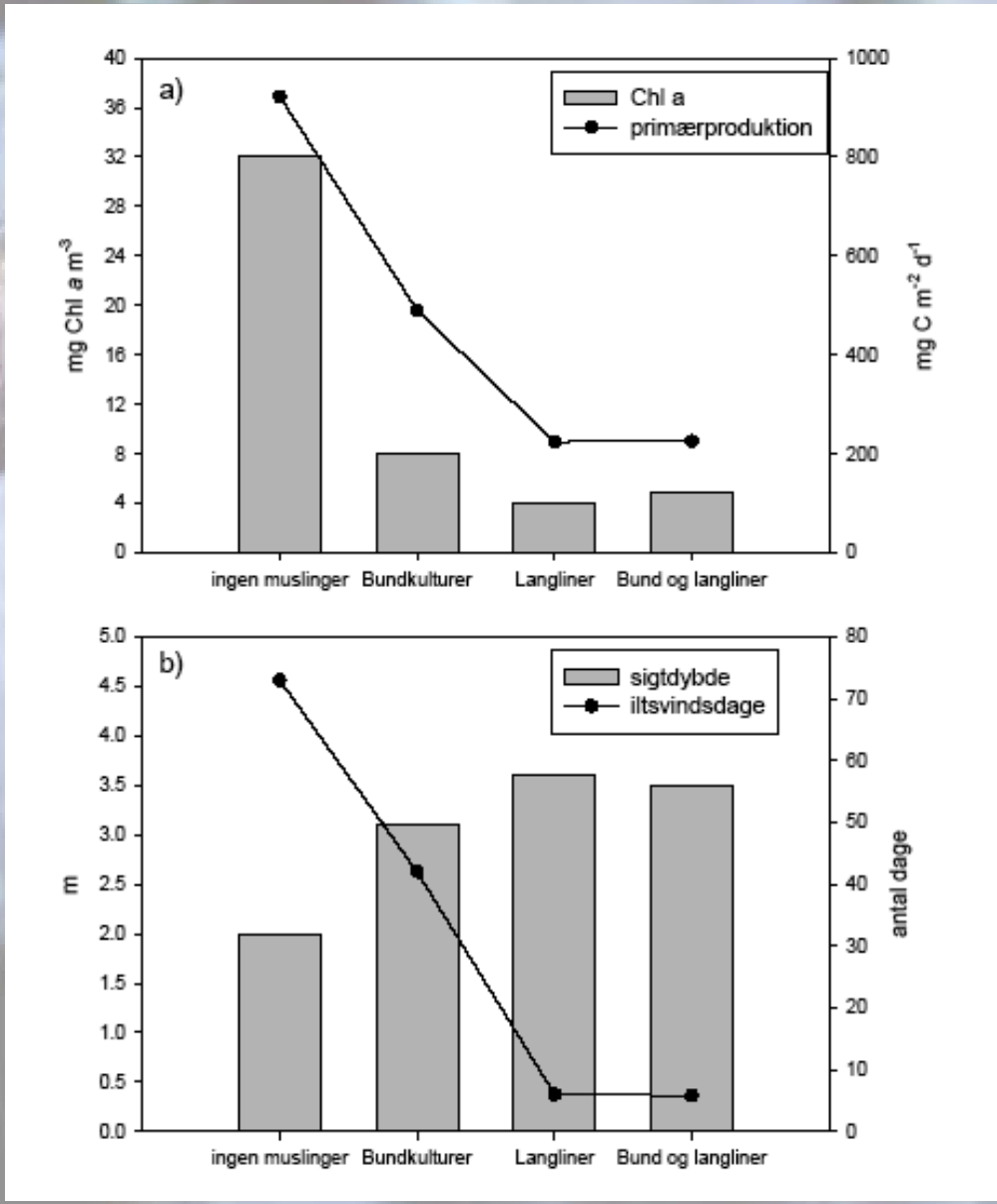



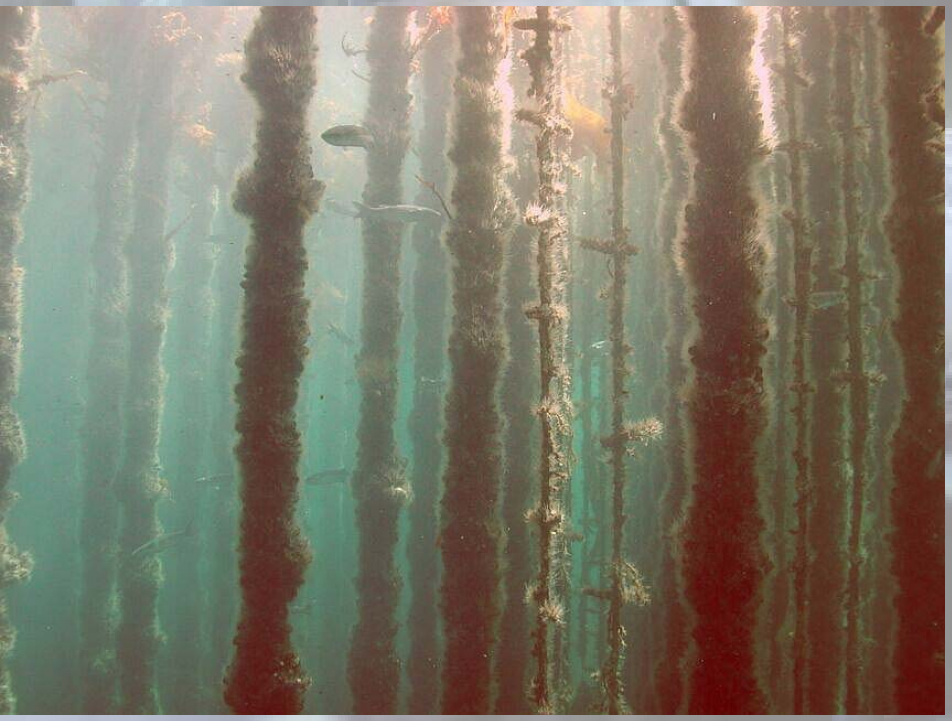



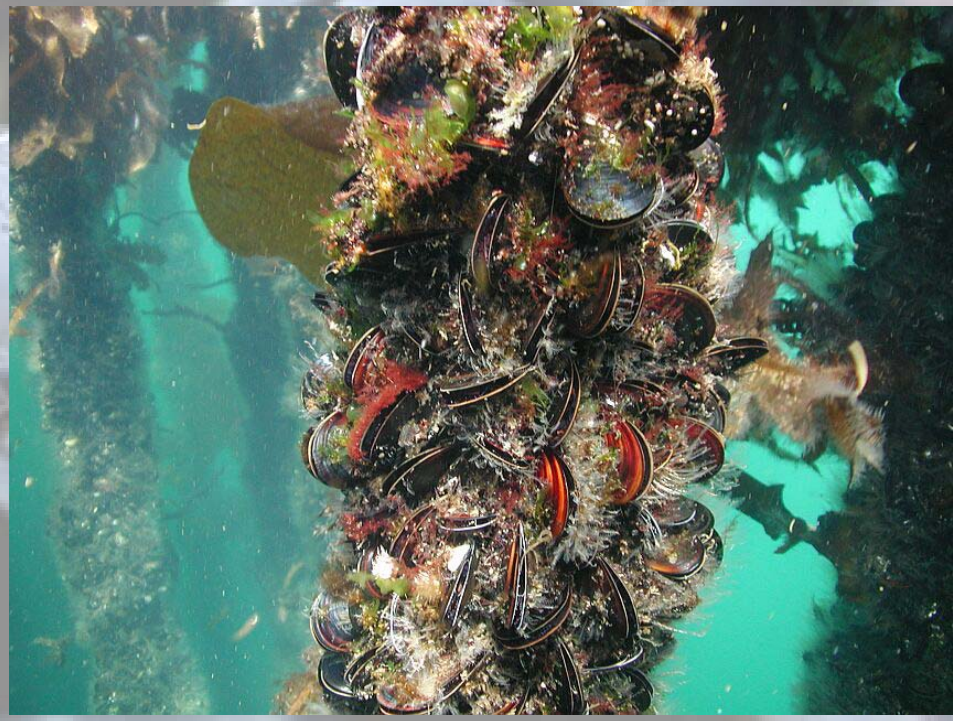



# ”Ringkøbing” syndrome in Skive Fjord



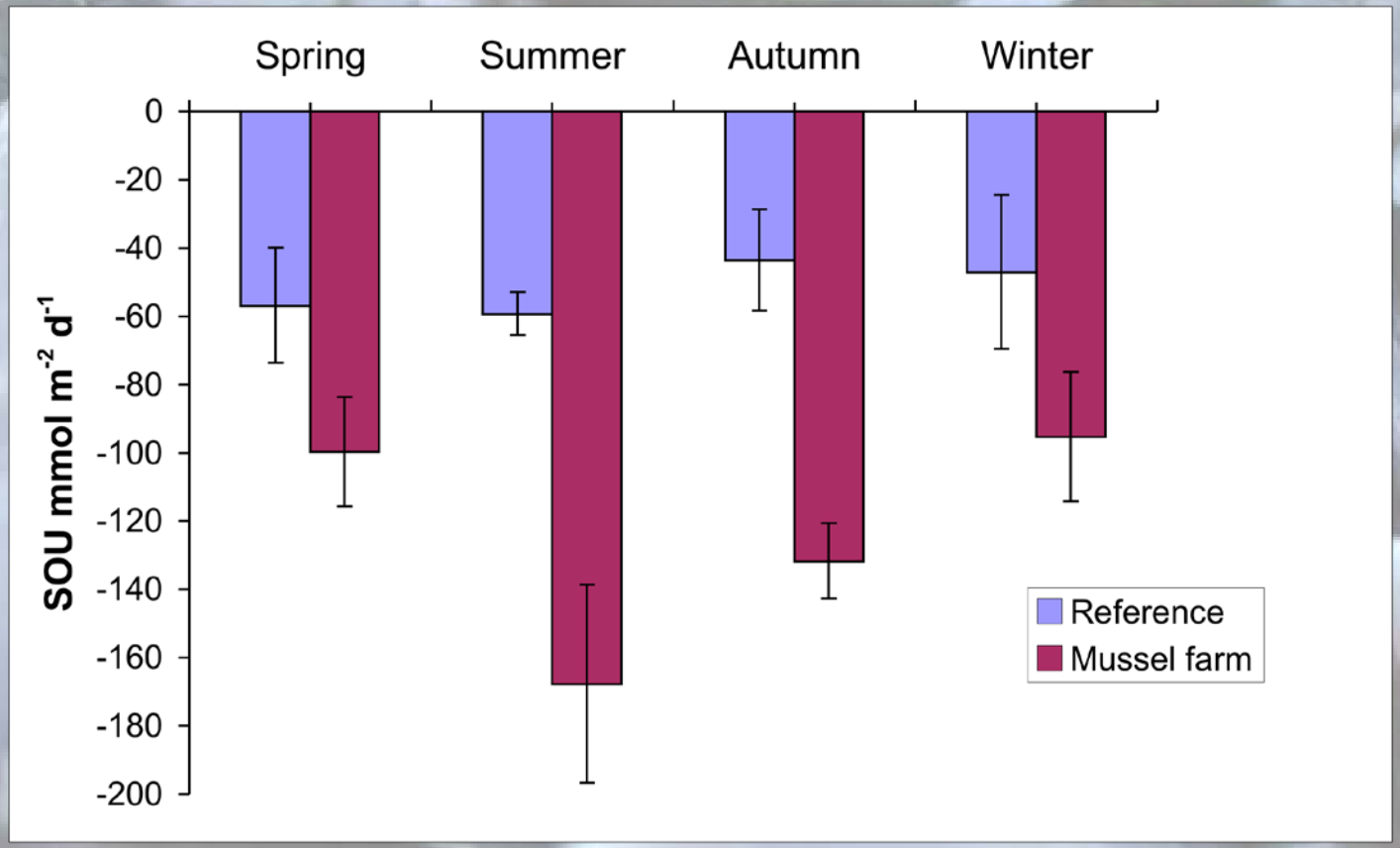
# Reef effect





# Visual pollution

# Sedimentation - effects



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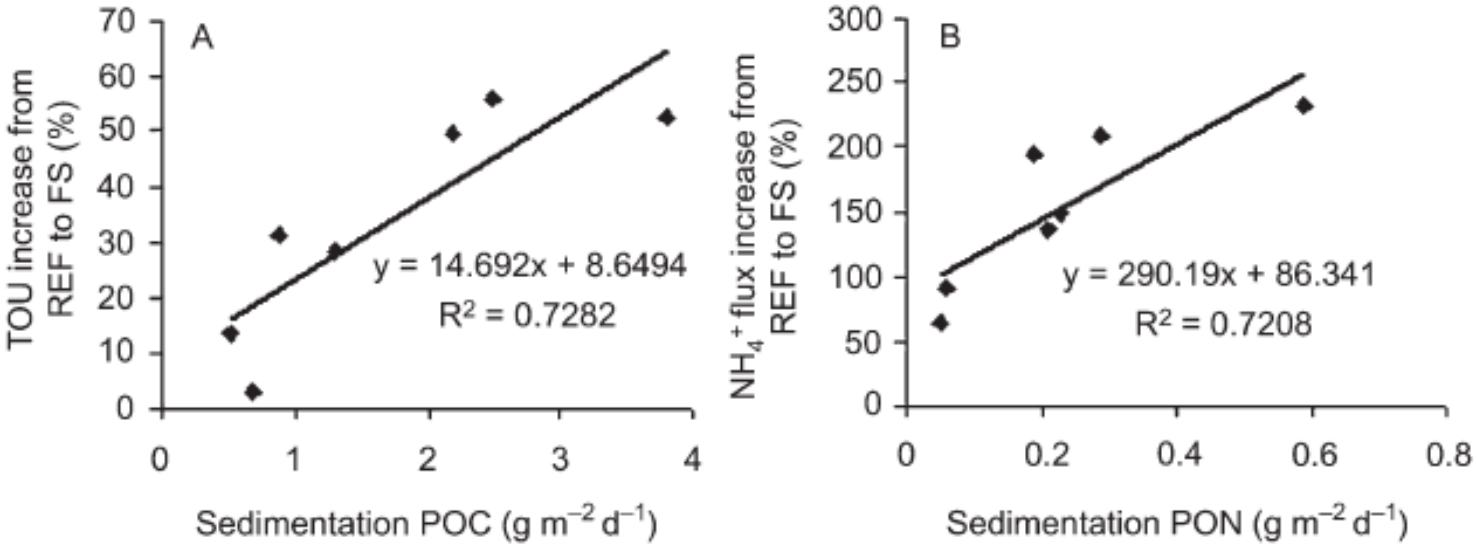
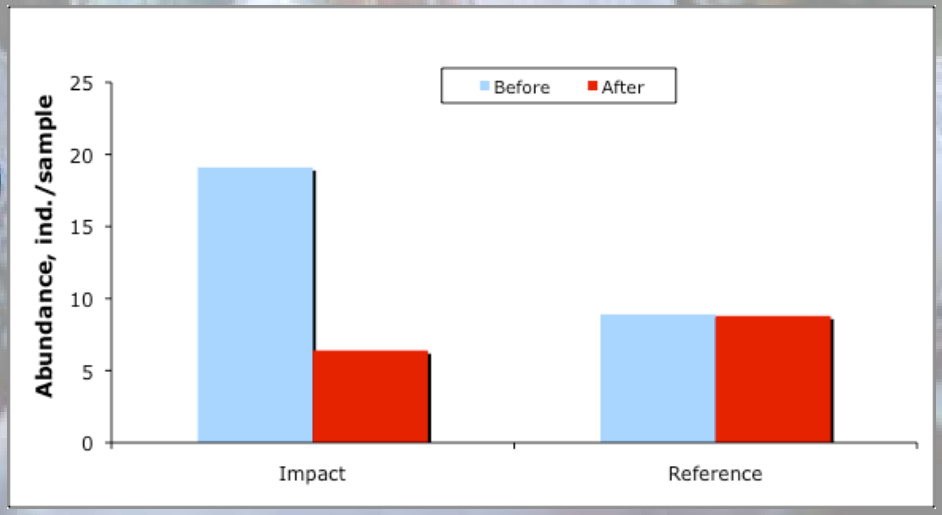
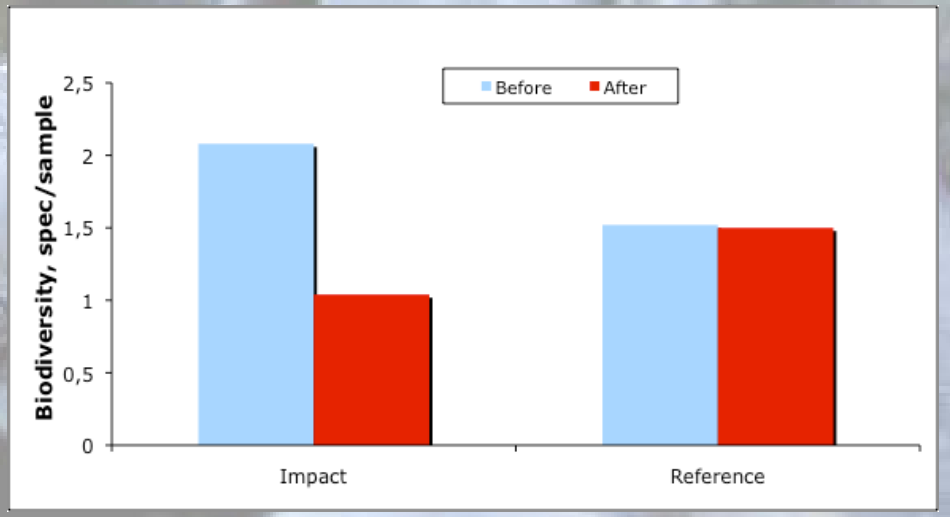


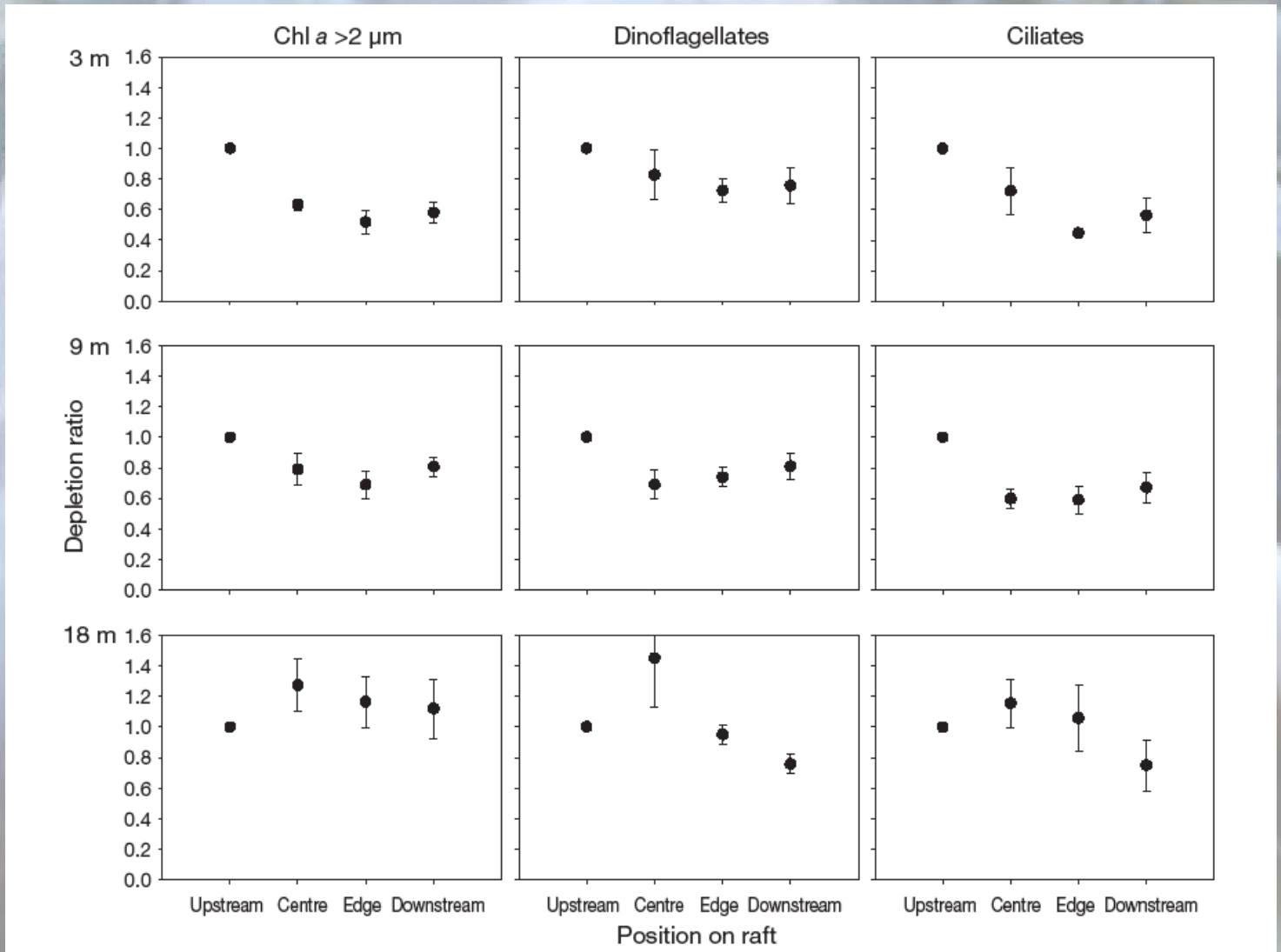

Carlsson et al 2009

# Benthic fauna



# Food web interaction



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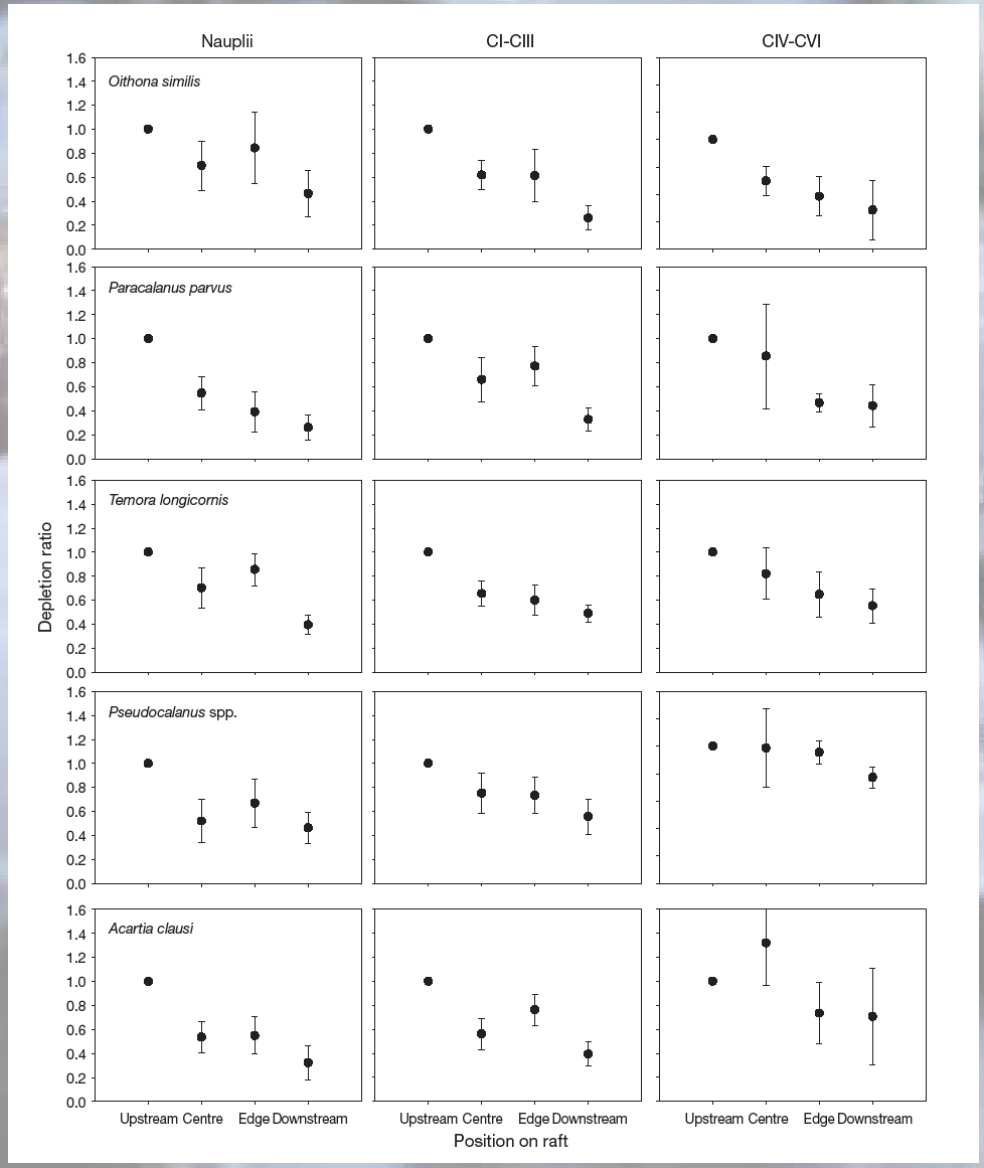

# MuMiHus 2010-13

- Danish Shellfish Centre
- National Environmental Research Institute
- DTU – National Institute of Aquatic Resources
- University of Southern Denmark
- Institute of Food and Resource Economics, University of Copenhagen
- Bolding & Burchard
- Dalhousie University
- NIWA – New Zealand
- Bedford Oceanographic Institute

BOLDING & BURCHARD

DALHOUSIE UNIVERSITY
Inspiring Minds

DSC

UNIVERSITYOFSOUTHERNDENMARK.DK

NIWA
Taihoro Nukurangi

FØDEVAREØKONOMISK INSTITUT
KØBENHAVNS UNIVERSITET

DTU Aqua
Institut for Akvatiske Ressourcer

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# MuMiHus work packages

- Full scale test of culture methods
- Environmental impact of mitigation culture
- Modelling of mitigation culture in Skive Fjord
- Growth limitations in blue mussels – the national perspective
- Management of mussel cultures as a mitigation tool
- Content of pollutants
- Stakeholder consultations

# kive Fjord

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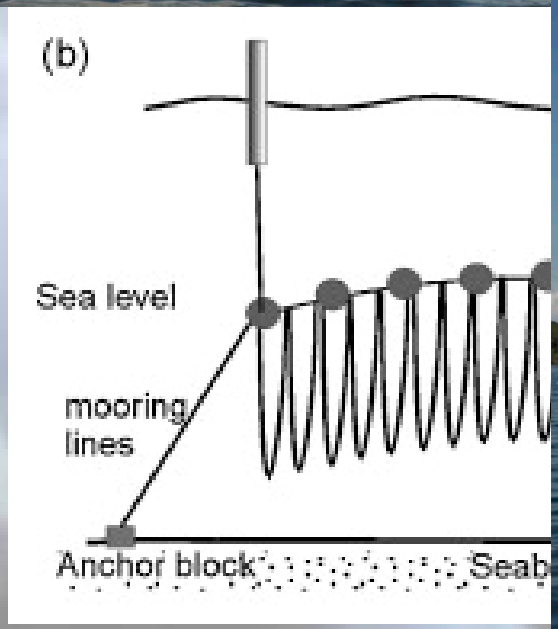
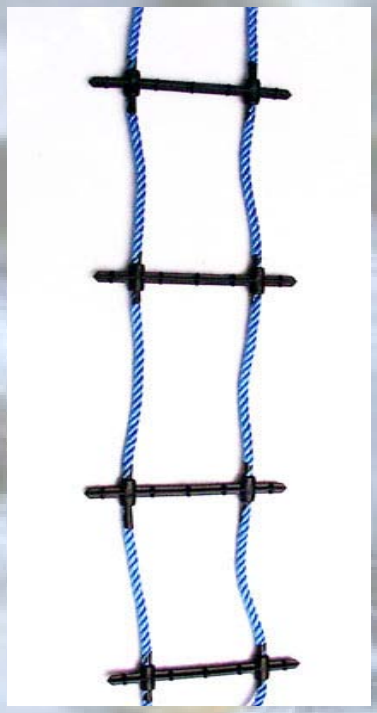
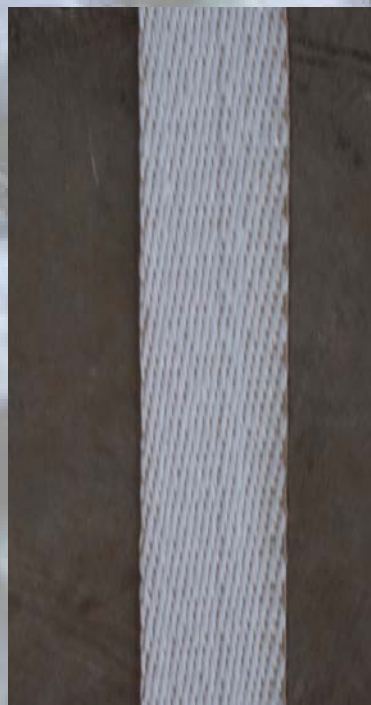
-3 m, 40-60 cm



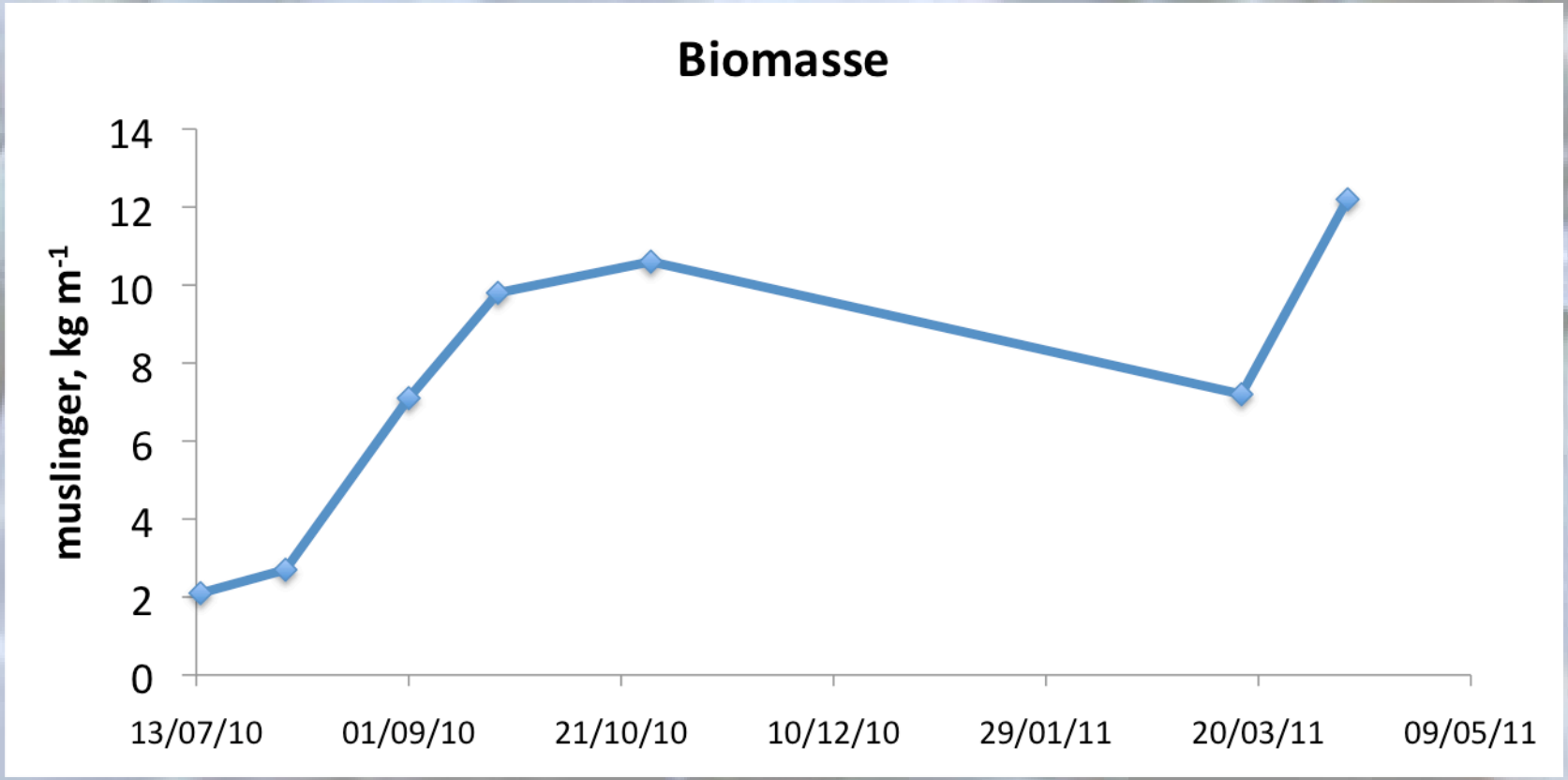

# Culture tests

-Growth media
  -2 types of woven nylon band
  -Xplora ladders
  -Aqua loop
-Depth of droppers
  -2 or 3 m
-Distance between loops
  -40 or 60 cm between droppers
-Time for harvest
  -November, March, May



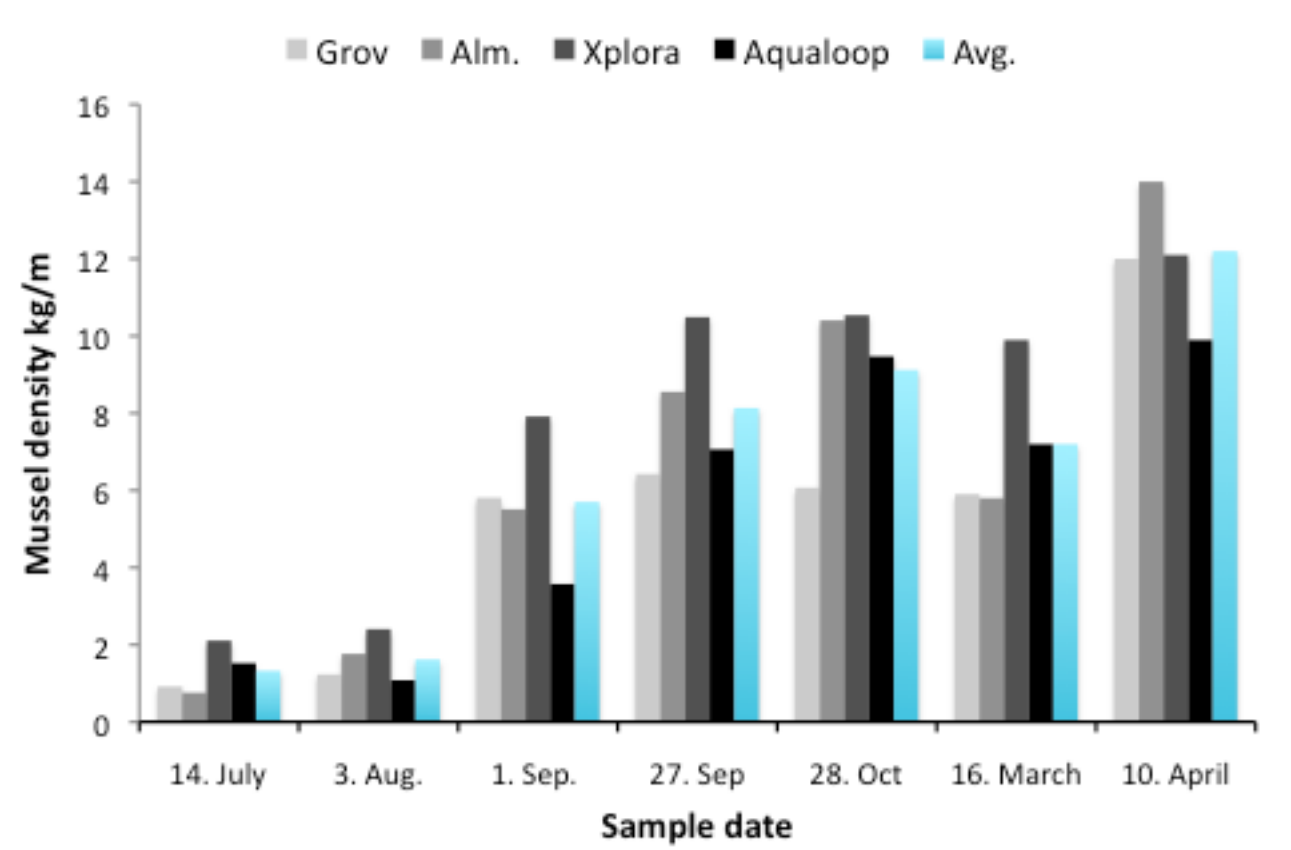


# Biomass development




In Skive Fjord we can produce 900-1000 t in 6-12 months

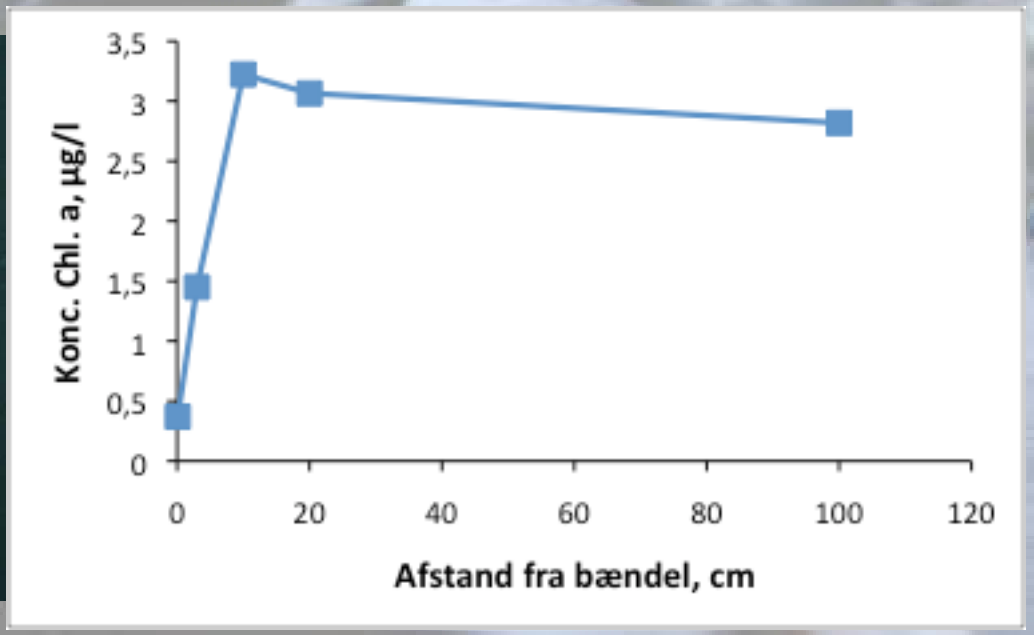
# Different growth media



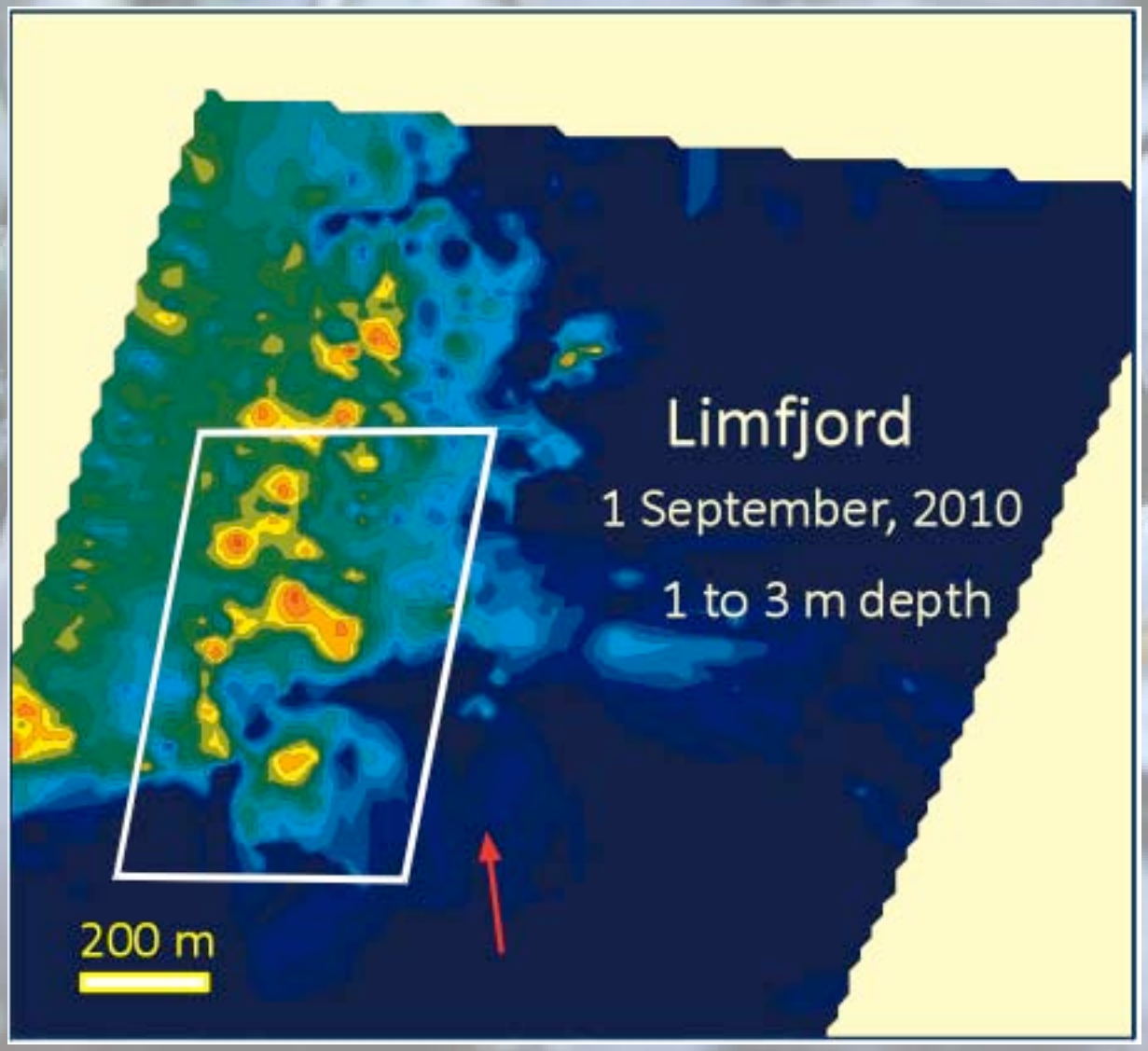
# Other issues

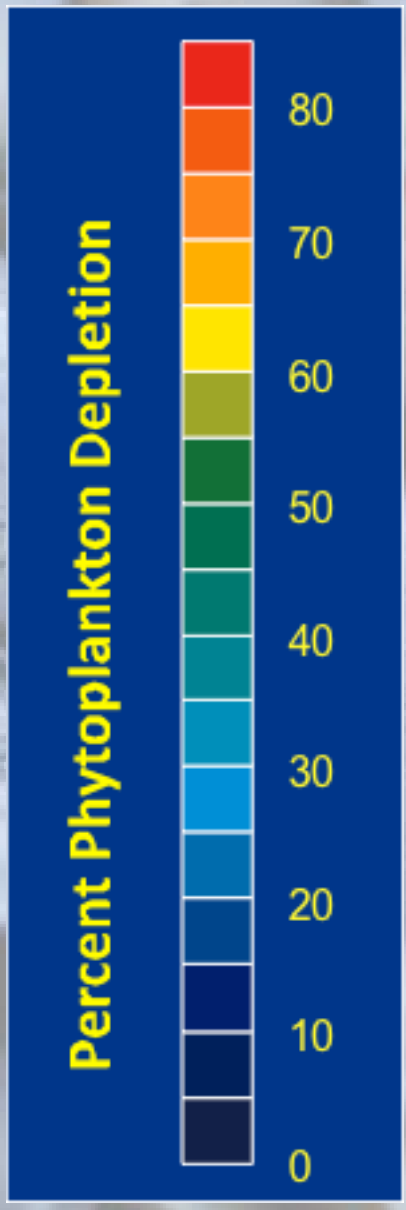
- Growth period vs. maintenance costs
- ice cover
- production method incl. harvest method
- predators

# Depletion– micro scale

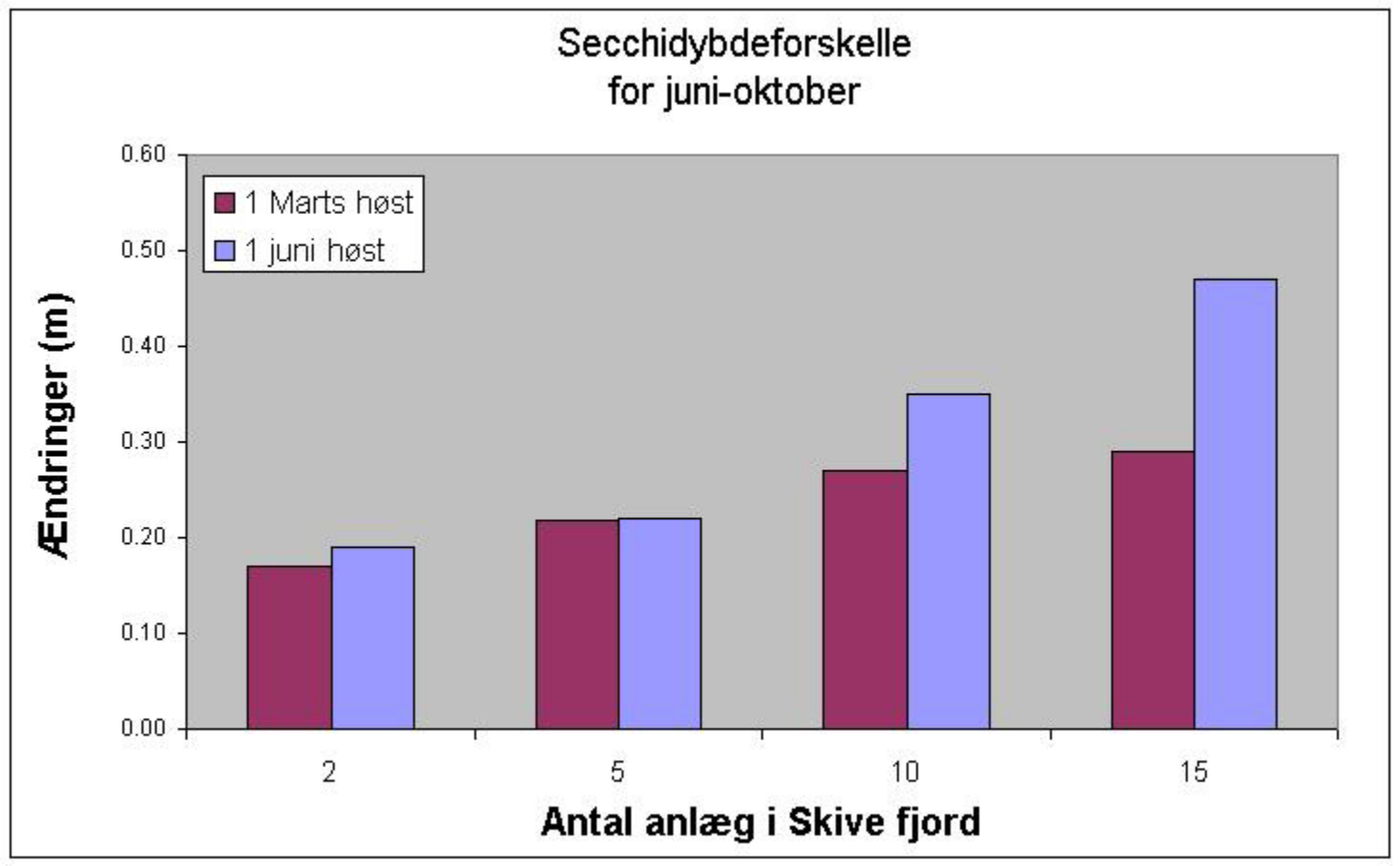


# Skive Fjord – depletion



# Skive Fjord – modelling



# Costs - first calculations

Harvest in November-December (900-1000 t):

- 1,10 DKK/kg mussels (incl. preliminary expenses and running costs) equals 110 DKK/kg N
- Including the ”Ringkøbing-syndrome” 10-15 kr/kg N

Potential cost reductions:

- Increased productivity (e.g. higher production volume per unit, optimization through large scale production)
- Introduction of other mitigation crops (sea weed)
- Payment for the mussels

# Next steps

- More realistic estimates of total costs including employment effect in rural districts
- Cost effective use of the mussels:
  - human consumption: canned mussels
  - feed for husbandry: separation of shell and meat
  - fertilizer: problems with EU regulations
- Optimization of production
  - upscaling by production on several units
  - enhanced production pr area
  - defining optimal harvest time
  - co-production with other mitigation crops
- Possibilities for integration of existing mussel production

# Considerations

- Is mitigation cultures of mussels a way of disguising the real problem?
- What is the proper use of ”green”-mussels?
- How to manage mitigation cultures – is it through tradable permits?
- What is the cumulative ecological impact of mitigation cultures?

# Thank you