# Effekt av strøm på økosystemene på dype bløtbunner ved oppdrettsanlegg

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# Ecosystem Responses to Aquaculture Induced Stress (ECORAIS). Prosjekt nr 190474, 01.01.2009 - 31.12.2011

Fellesprosjekt for å undersøke hvordan utslipp fra matfiskanlegg for laks spres og påvirker omliggende miljø

- partikkeltransport
- omsetning og bunnpåvirkning
- vekst av alger og filtrerende organismer

Havforskningsinstituttet

NIVA

Uni Research (UiB)

# Background

- Norwegian salmon industry has rapidly grown since 1999
- Concerns on environmental sustainability
- Impact of intensive fish farming in shallow soft sediment benthic ecosystems
  - Biogeochemical processes (Holmer 2007)
  - Microbial processes (Valdemarsen et al. 2009)
  - Structure and biomass of faunal communities (Hargrave et al. 2008)
- Norwegian fish farms relocating to deeper, more dynamic locations

# Project aims

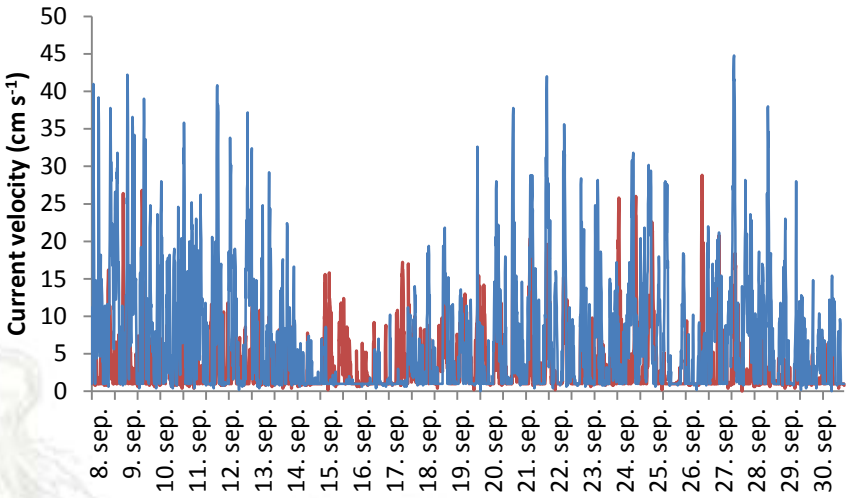
- Understand benthic ecosystem responses to aquaculture induced stress at 2 fish farming locations (similar production) with contrasting current regimes over a production cycle
  - High and low flow systems
  - Farming and reference sites (~700 m apart)
- Holistic approach
  - Mineralisation processes
  - Biogeochemical responses
  - Fauna community responses

# Methodology

- Sedimentation and current measurements
- Benthic fluxes using sediment cores
  - Standard flux measurements (n=6)
    - **$O_2$**, $TCO_2$, $NH_4^+$
- Pore water chemistry (biogeochemical responses)
  - Slice sediment cores (n=3)
    - 0-1, 1-2, 2-4, 4-6, 6-8 and 8-10 cm depth
    - Extract chemical compounds
      - **$SO_4^{2-}$**, **$TH_2S$,** $TCO_2$, $NH_4^+$
- Infauna composition
  - Extracted from sediment cores (n=3)

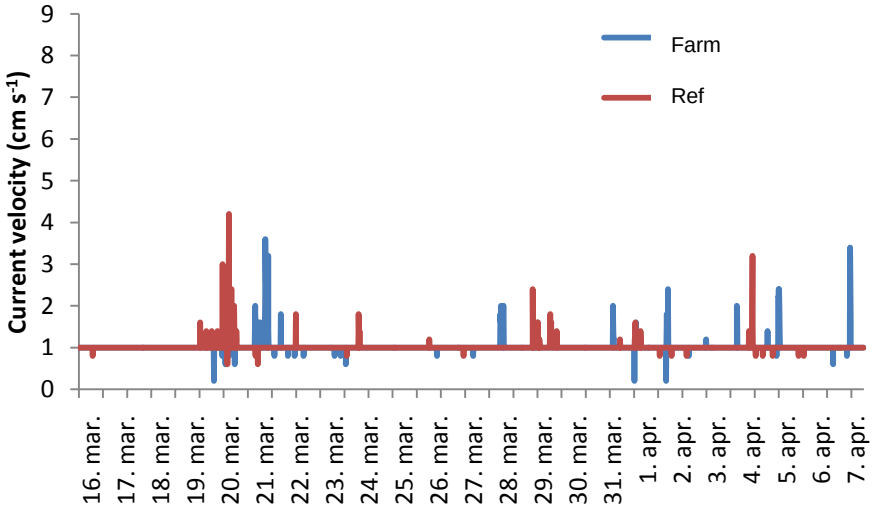
# Current velocity

## Outer fjord




Greater dispersal:
Lower localised benthic impact

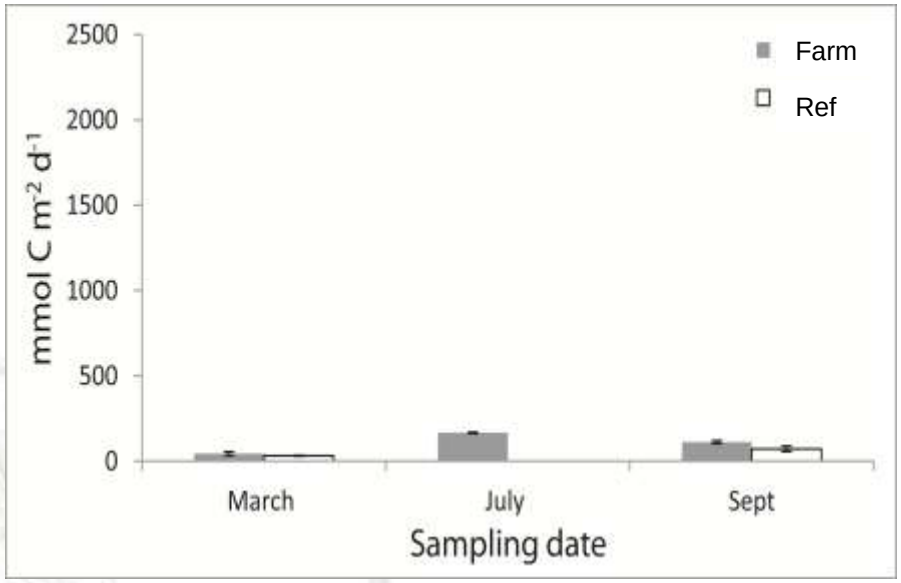
## Inner fjord



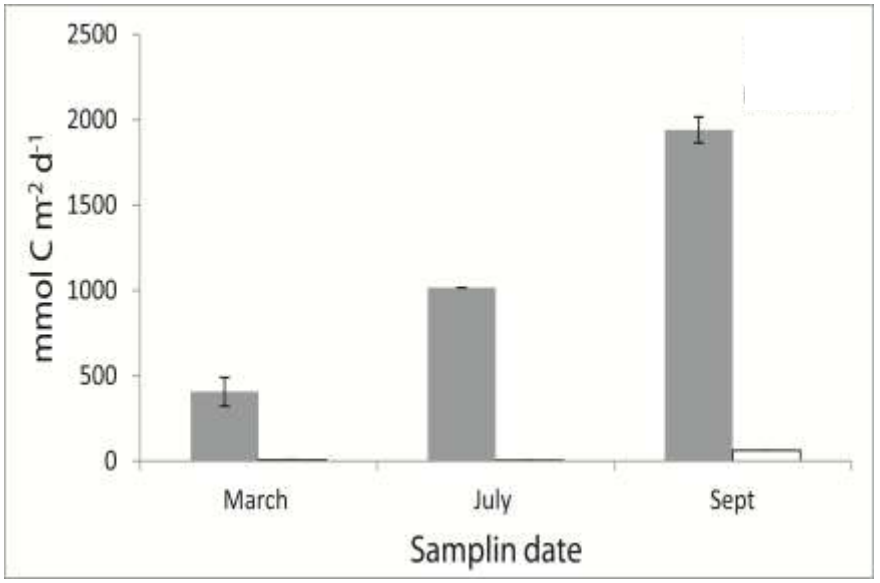

Lower dispersal:
Greater localised benthic impact

# Sedimentation (POC)

Outer fjord



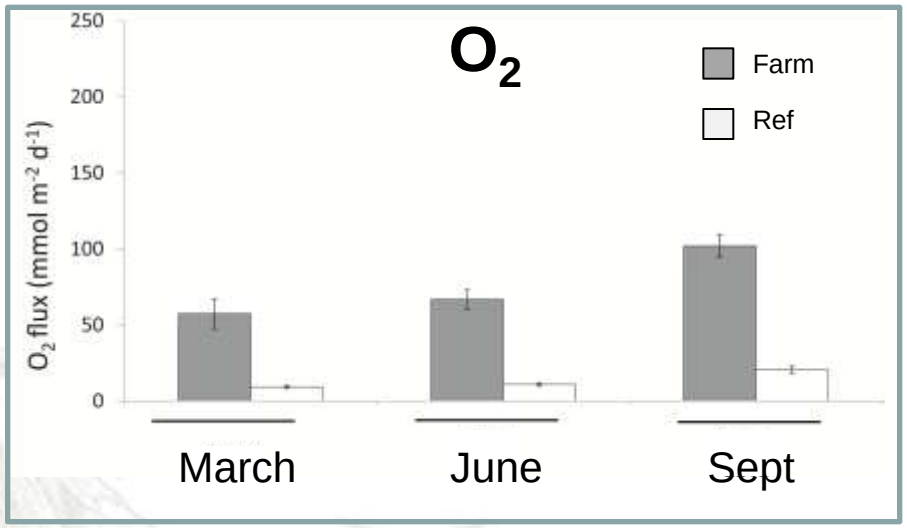

Inner fjord



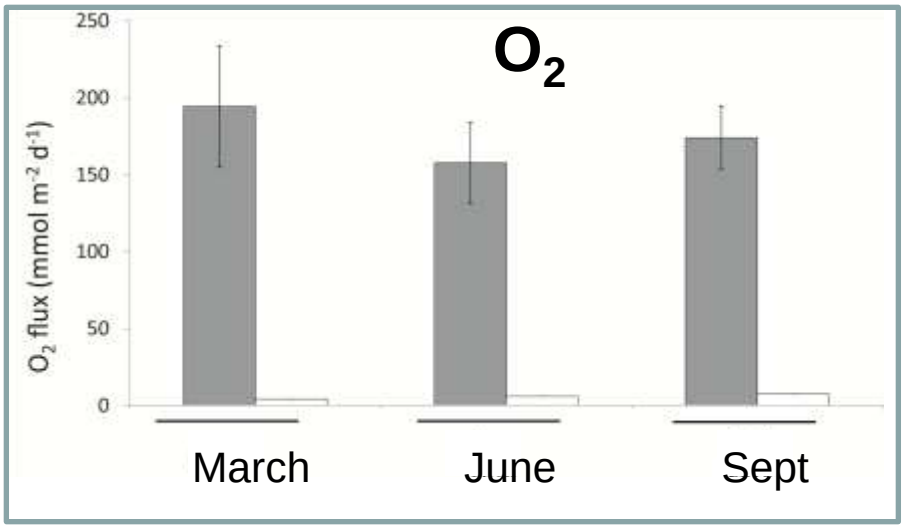

- 6 – 17 times higher deposition of organic carbon at inner-fjord location

# Benthic fluxes

## Outer fjord




## Inner fjord

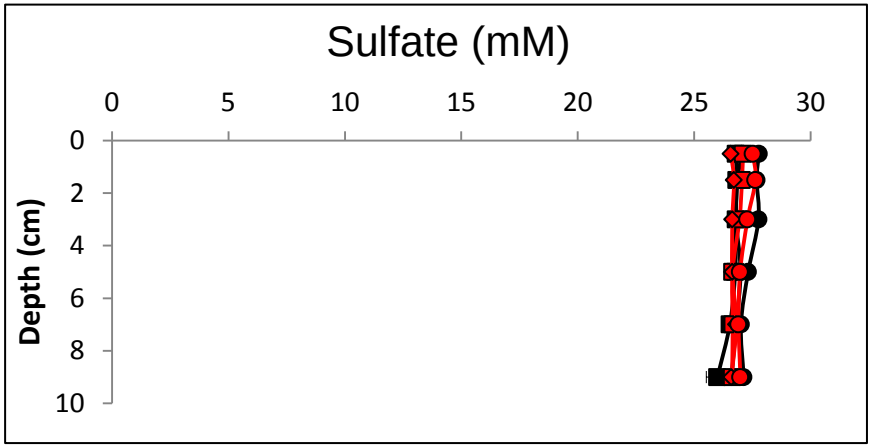


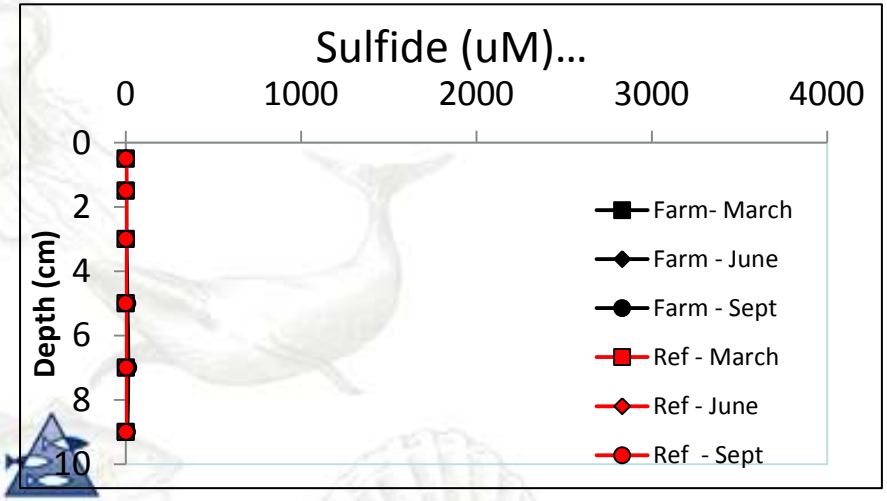

- Up to 6 X higher $O_2$ consumption at farm location

- Up to 46 X higher $O_2$ consumption at farm location

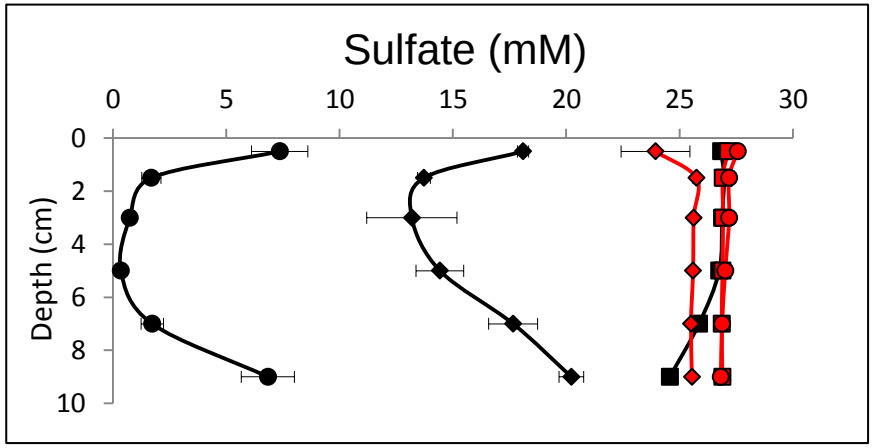
# Porewater chemistry

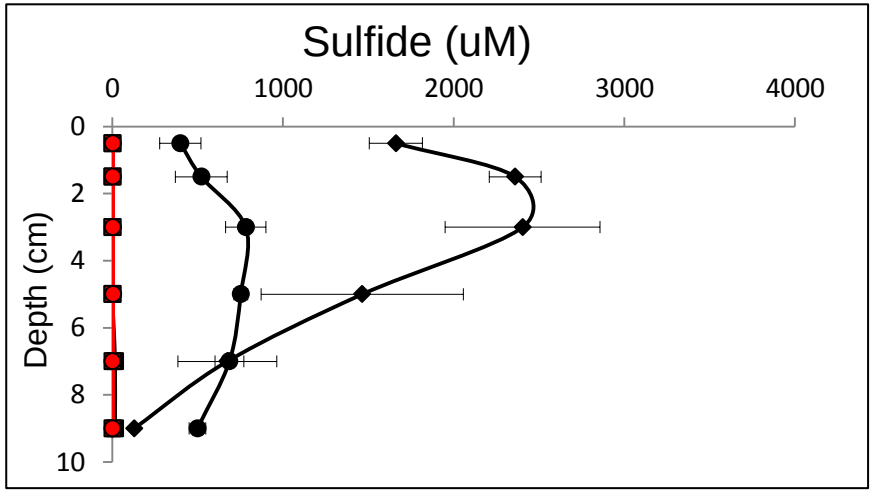
## Outer fjord



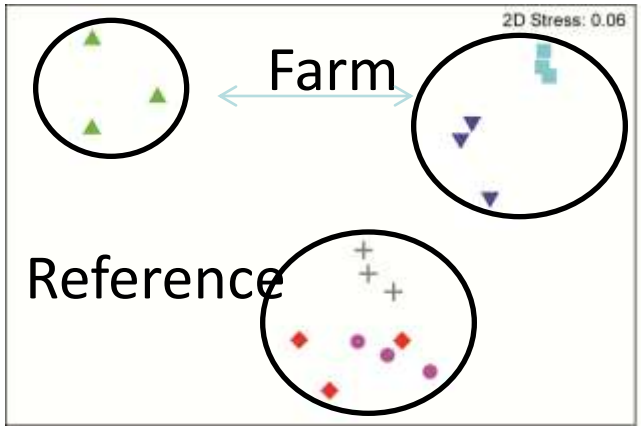

## Inner fjord



# Infauna composition

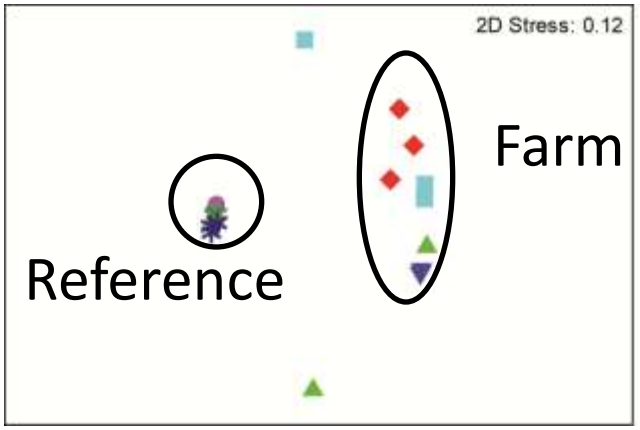
## Outer fjord




| Farm | March '10 | June '10 | Sept '10 |
|---|---|---|---|
| Diversity H' | 2.39 | 2.40 | 1.48 |

| Reference | | | |
|---|---|---|---|
| Diversity H' | 2.71 | 2.66 | 3.14 |

## Inner fjord




| Farm | March '10 | June '10 | Sept '10 |
|---|---|---|---|
| Diversity H' | 0.15 | 0.24 | 0.00 |

| Reference | | | |
|---|---|---|---|
| Diversity H' | 2.11 | 2.45 | 2.08 |

Ref

# Summary of results

- Benthic responses differ between contrasting fish farming locations
  - Environmentally driven (current velocity)
- Increased benthic fluxes at outer fjord farm
  - Lower diversity and shift in infauna composition
  - No impact on porewater chemistry
- Organic overloading at inner fjord farm
  - Extinction of fauna
  - Breakdown in biogeochemistry
    - Changes / reduction in biological/microbial processes

# Utilisation of results for advice

- First detailed measurements in a Norwegian aquaculture setting over a production cycle and at deep localities
  - Biological and biogeochemical responses
- Two tools for monitoring/advice giving for aquaculture
  - MOM-System (revise) – Benthic impacts
  - AKVAVIS (development) - ICMS
- Combining data with existing literature aim to establish thresholds for organic input on benthic responses

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- Molecular and chemistry labs
  - Sample analysis and lab space
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  - Sample processing
- Børge Alfstad (HI)
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