

# Miljørisiko tobis

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Lesser sandeel (*Ammodytes marinus*)  
A key-species in the North Sea ecosystem

# Life cycle of sandeel

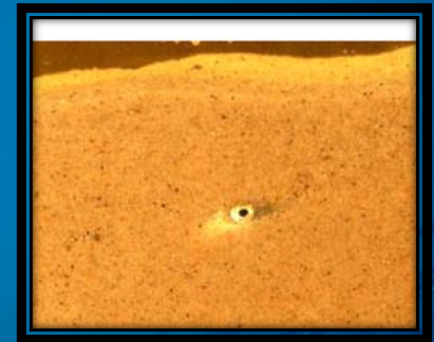
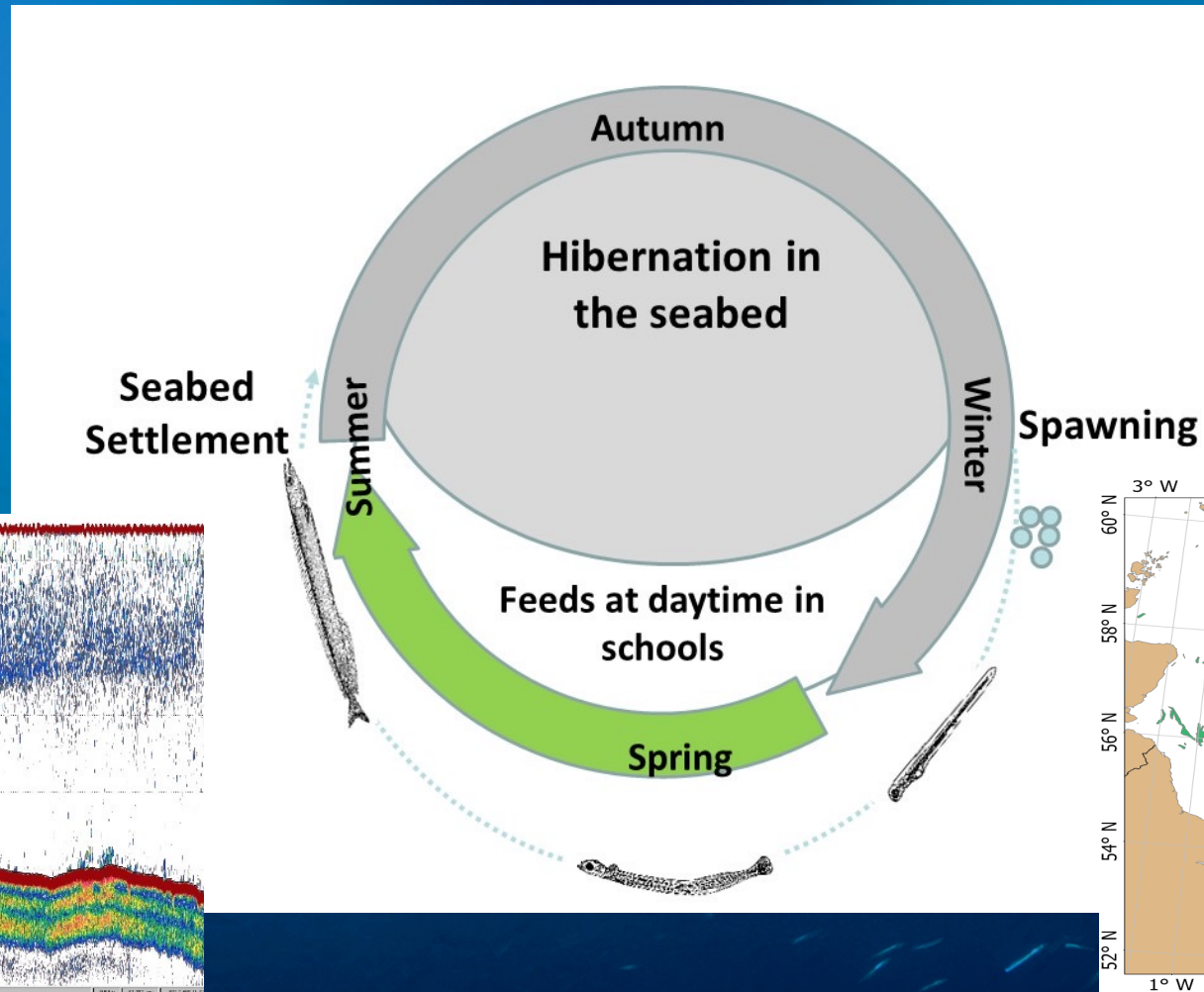
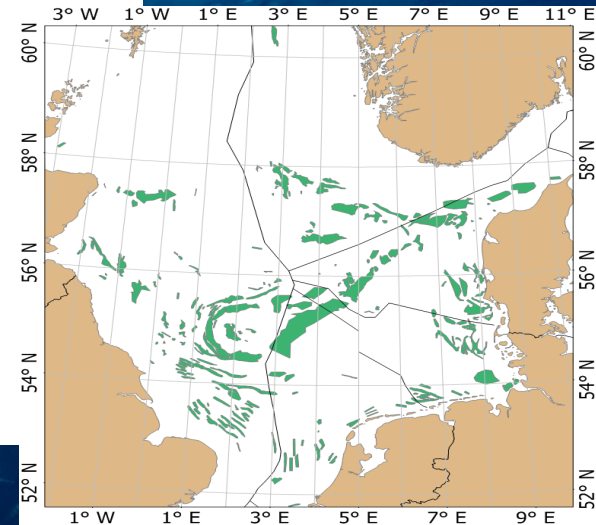
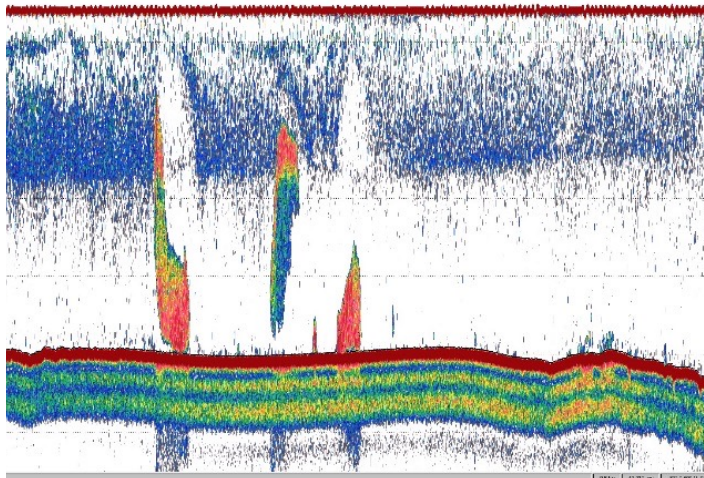
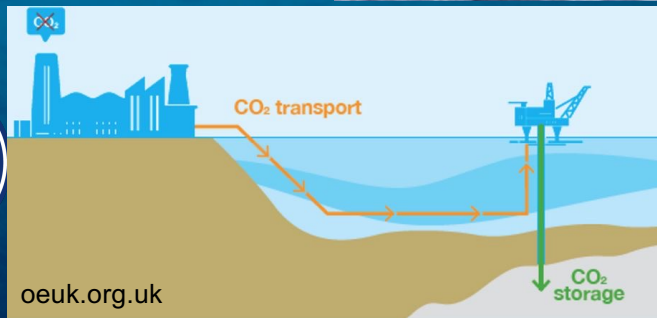


Photo: Behrens et al. 2007

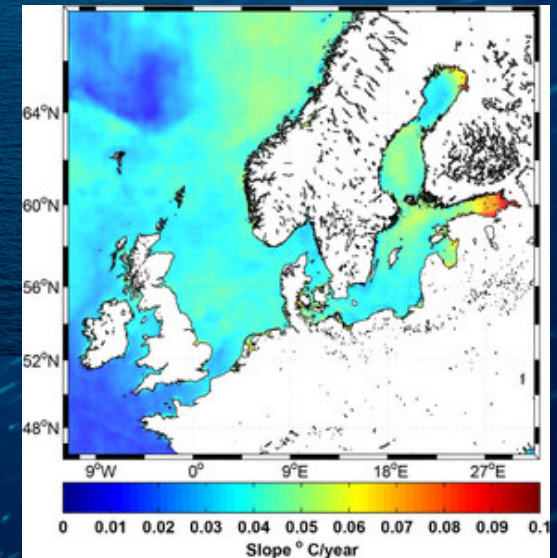


# Increased cumulative impact:

- Petroleum
- CCS
- Windfarming
- Fishing
- Climate change



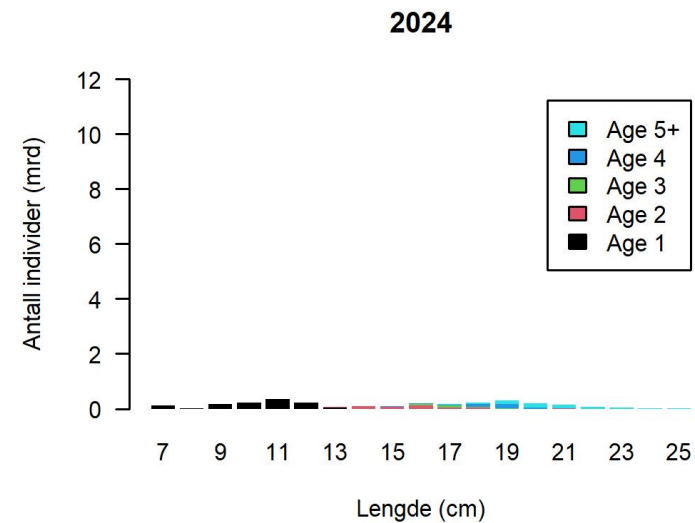
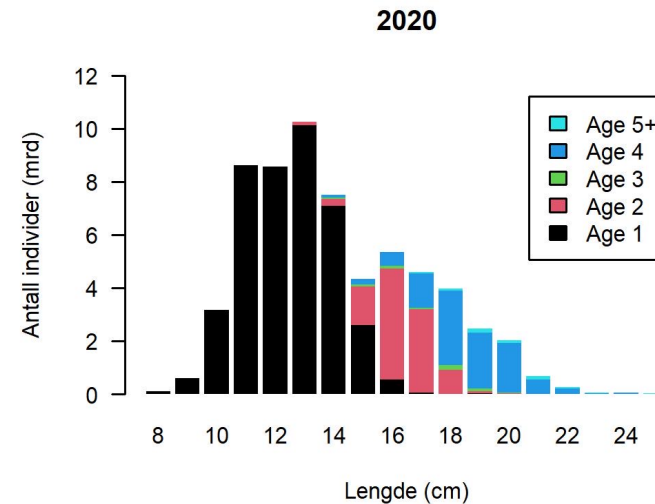
oeuk.org.uk



# Area management

- Protection of sandeel areas (SVO)
- National area based fishery management
- Activity demand tailored risk assessment

What about the larvae?



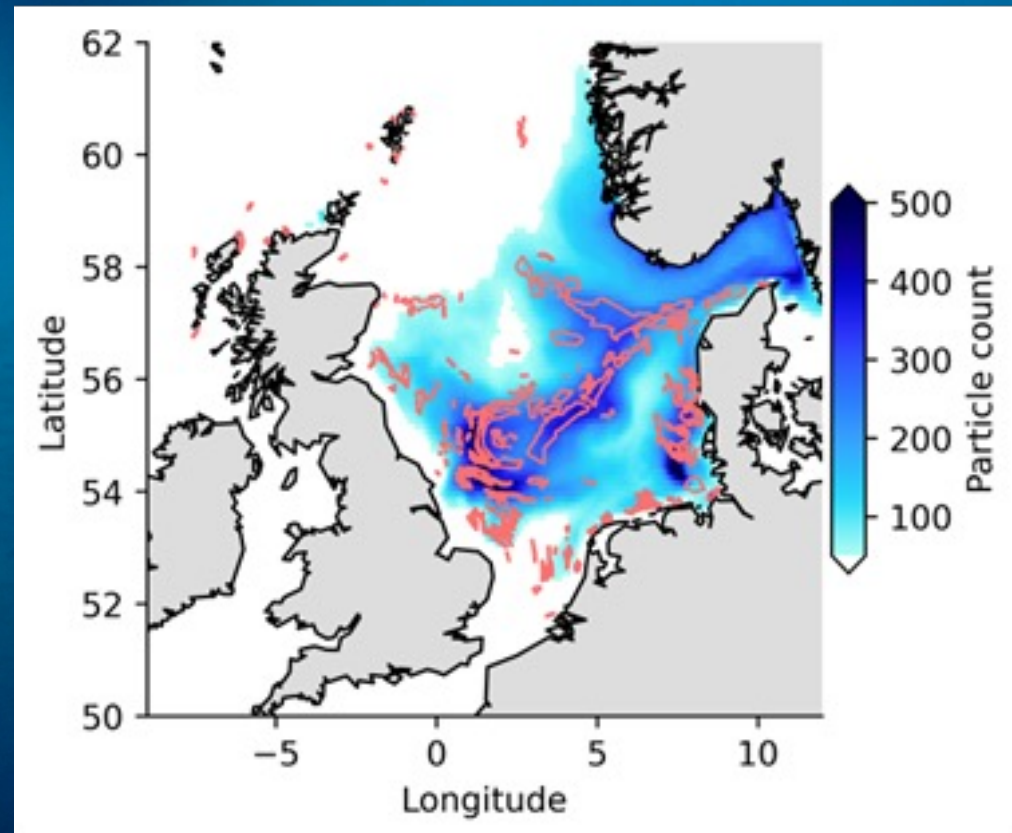
# KnowSandeel Projects



+Industry

## Where are the sandeel larvae?

- Need protection?
- Recruitment in between areas?
- Drift paths?
- Improve initial larval drift model



# KnowSandeel Projects

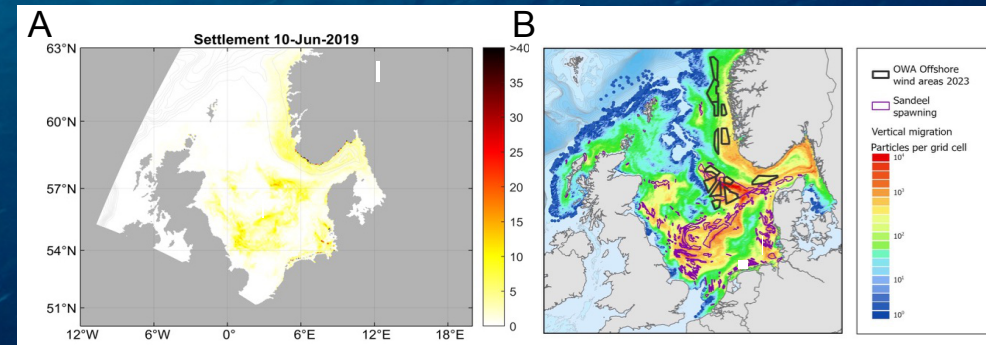
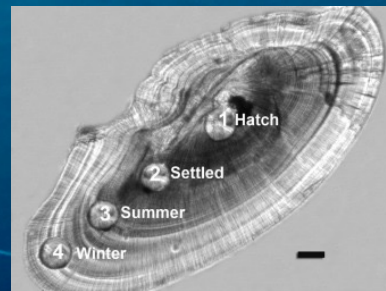
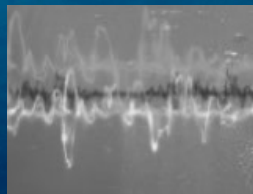
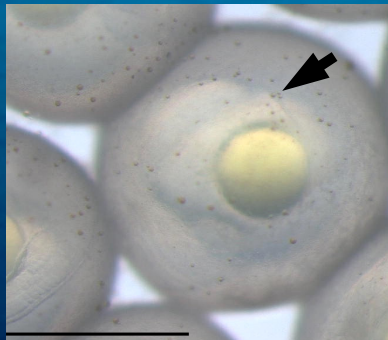
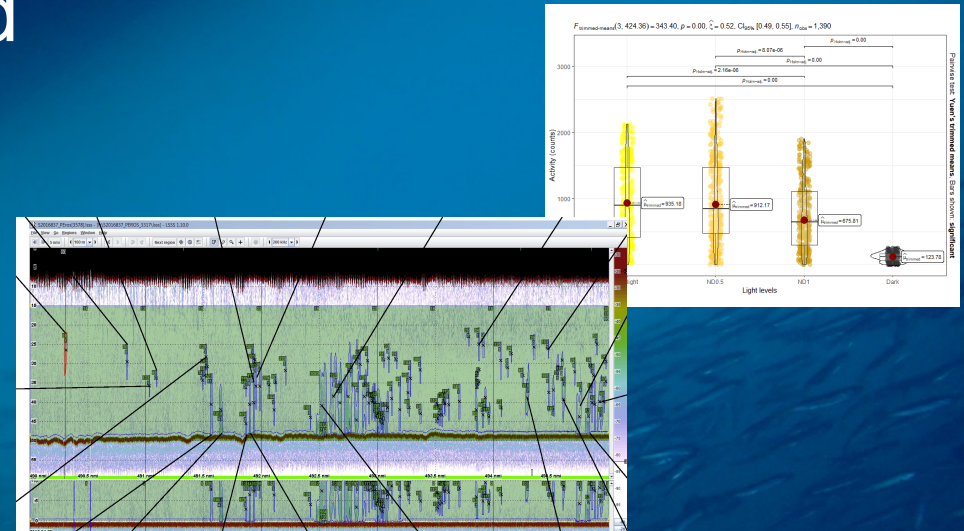
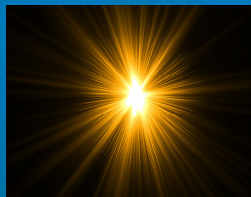


+Industry

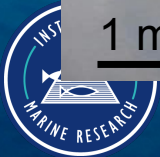
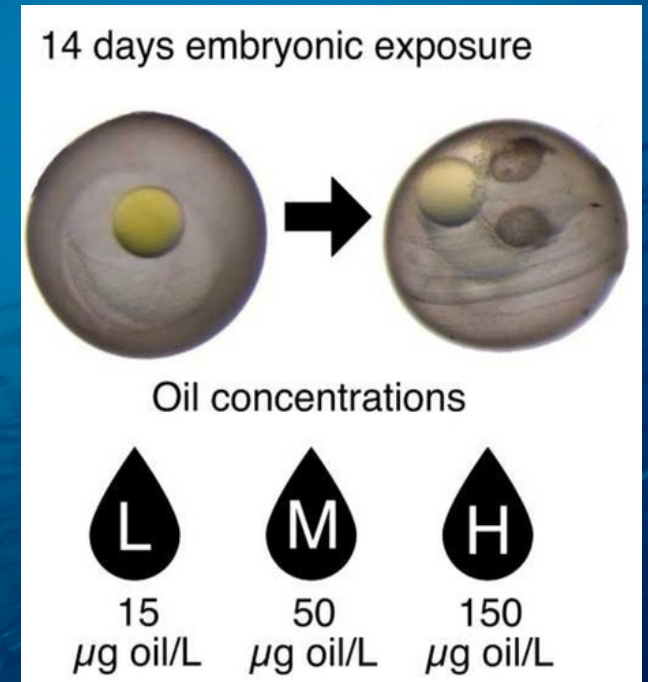
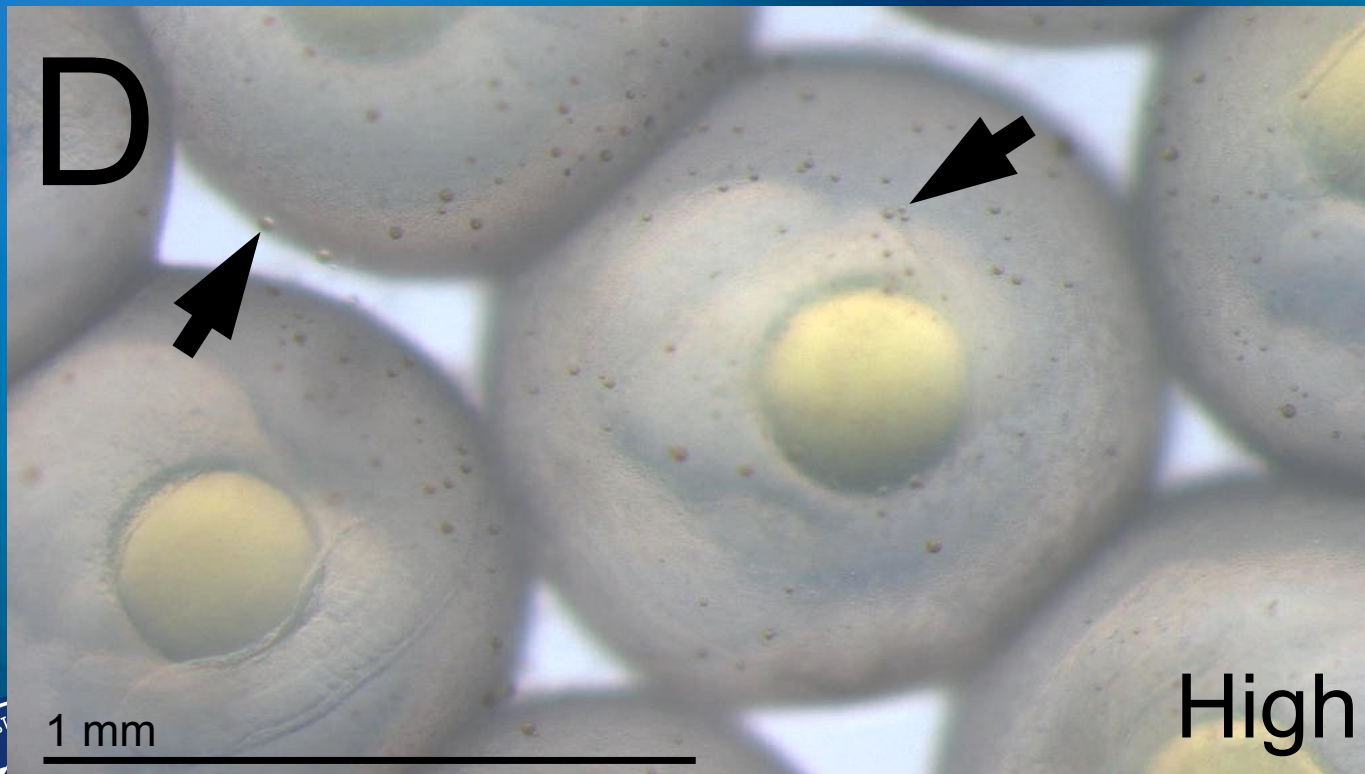
Knowledge we have achieved

What do we aim for

Knowledge gaps



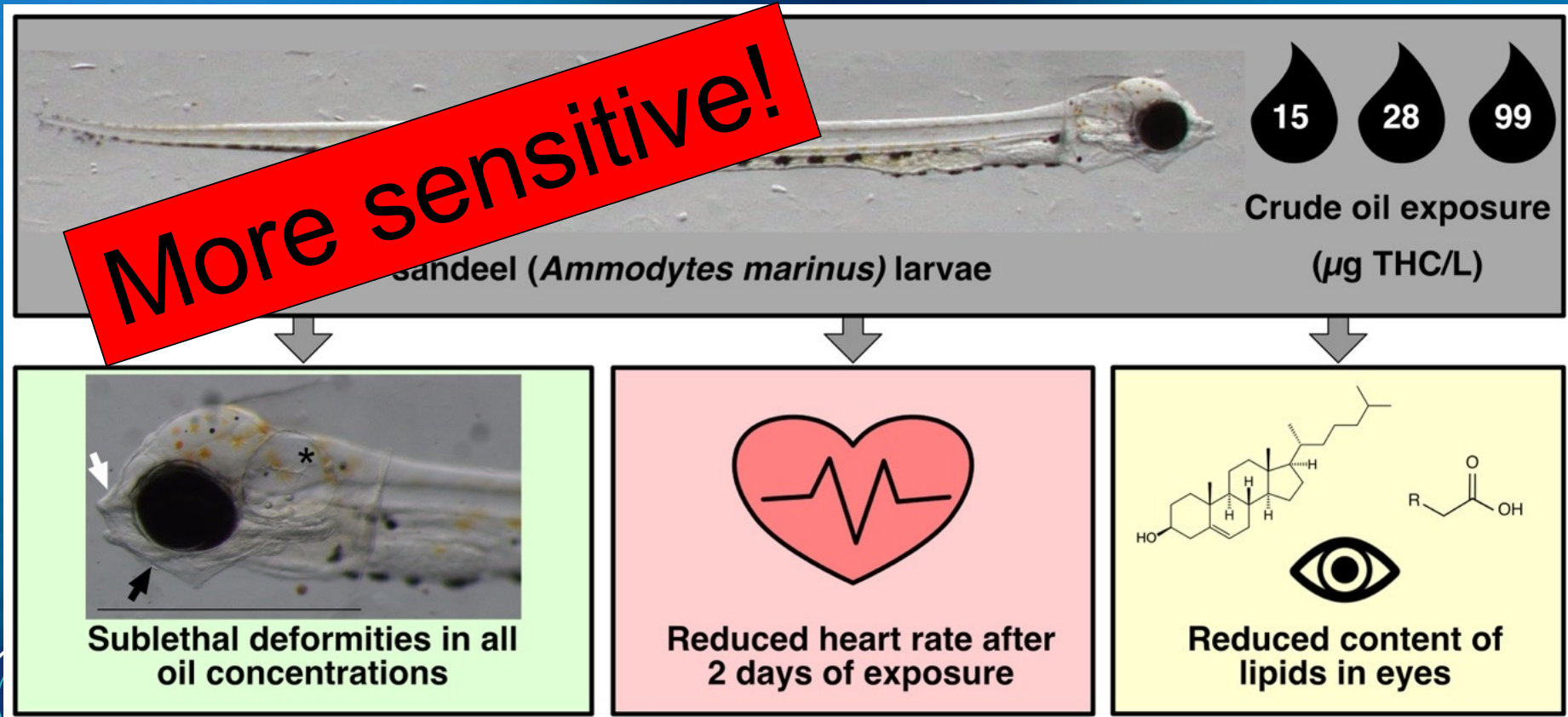
# Relatively low oil sensitivity in eggs



Sørhus et al. 2024



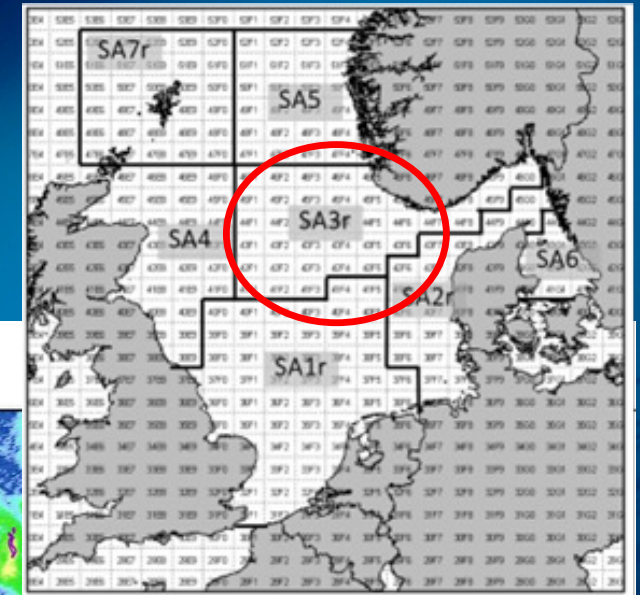
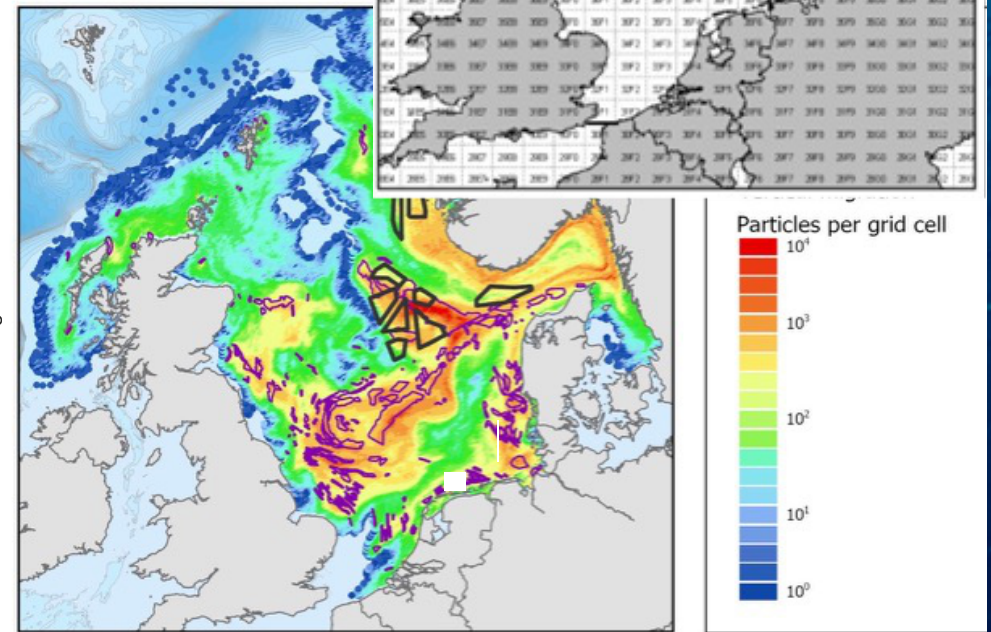
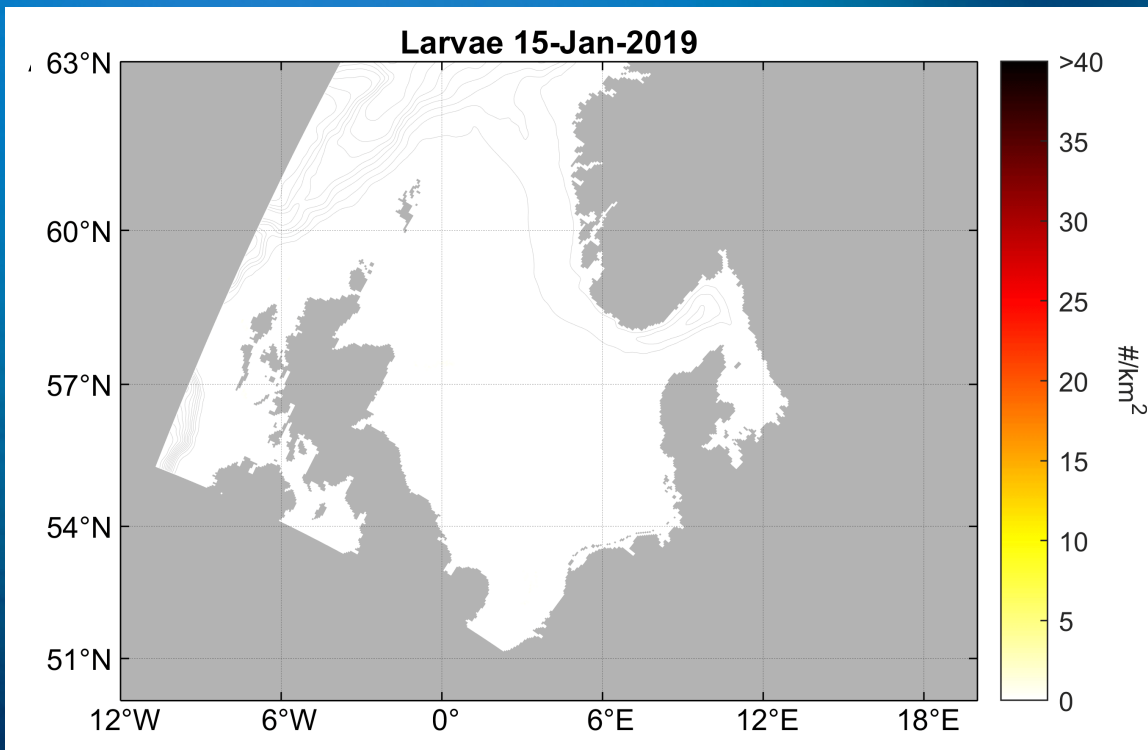
# Relatively high oil sensitivity in early larvae



Sørhus et al. 2026



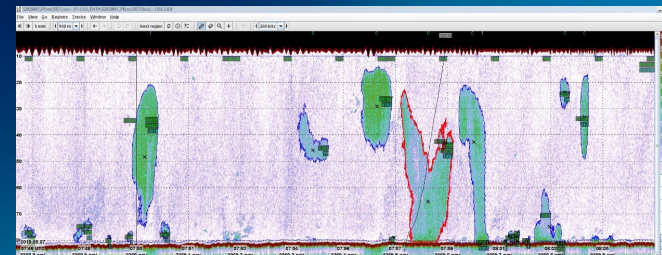
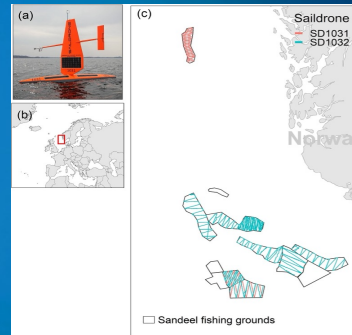
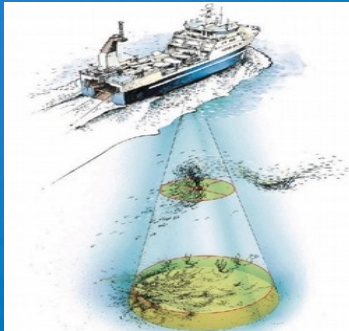
# Improved larval drift model



Frøysa et al. to be submitted

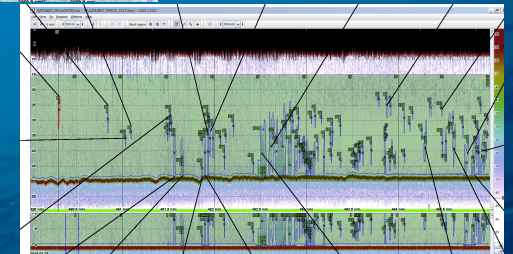
# Validation of drift model

- Acoustics

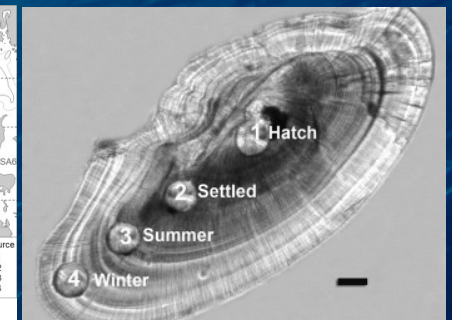
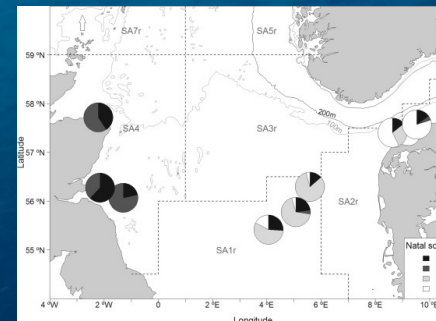
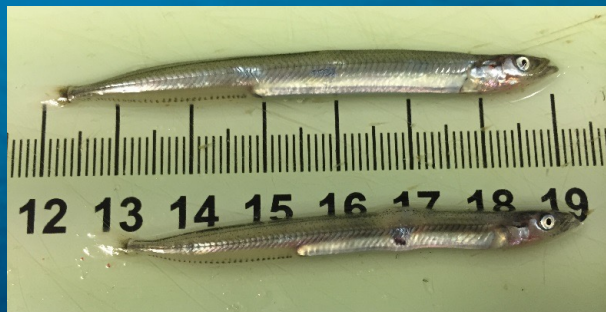


Adults

Larvae



- Microchemistry and genetics

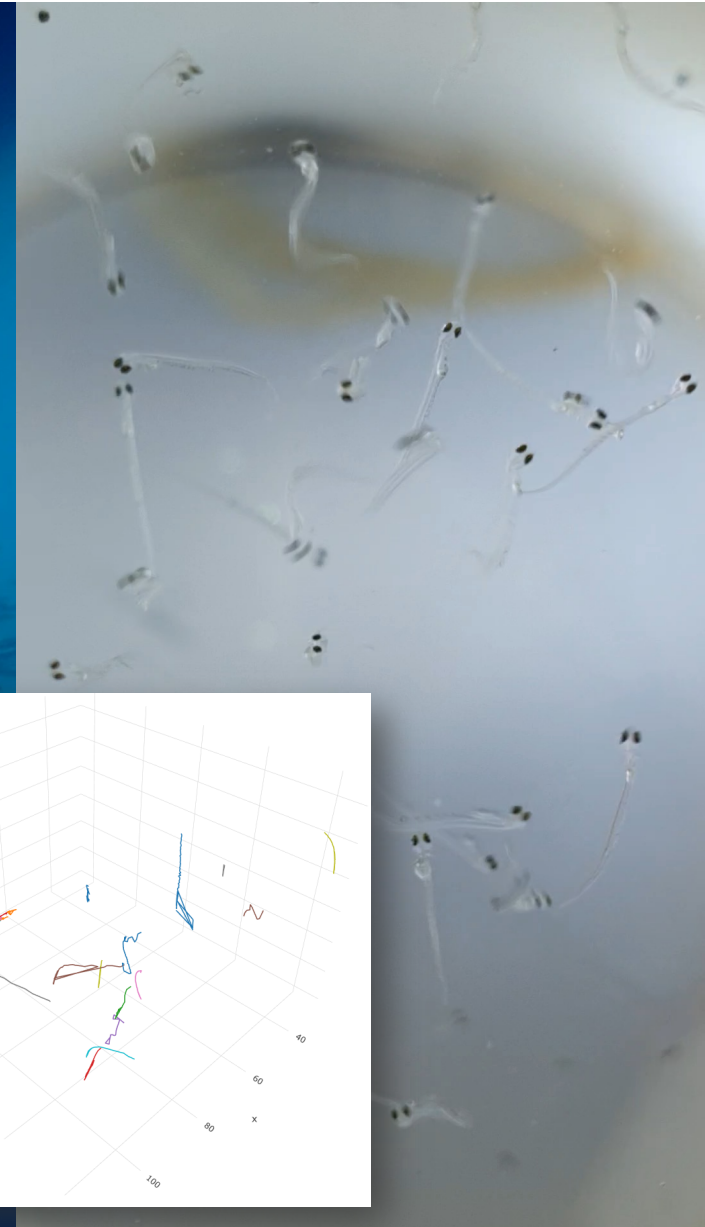
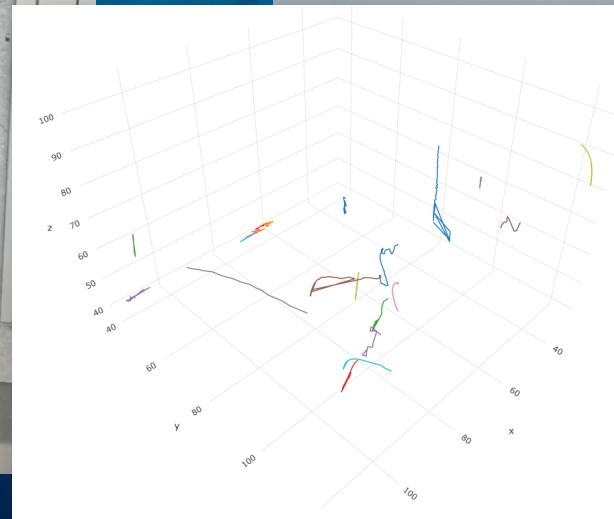
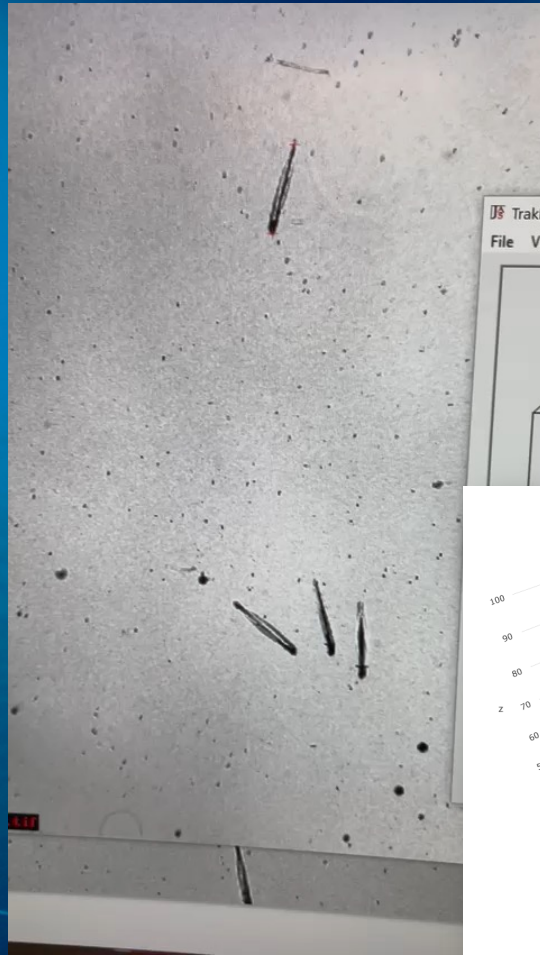
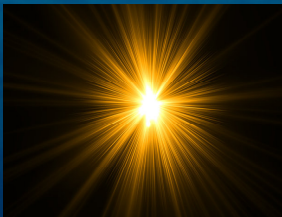
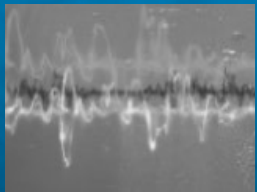


Drifters

# Include larval behavior

Natural behavior

Stressor induced behavior



# Larval sensitivity to light

Activity in response to light levels at different stages

- Sensitivity increase with age

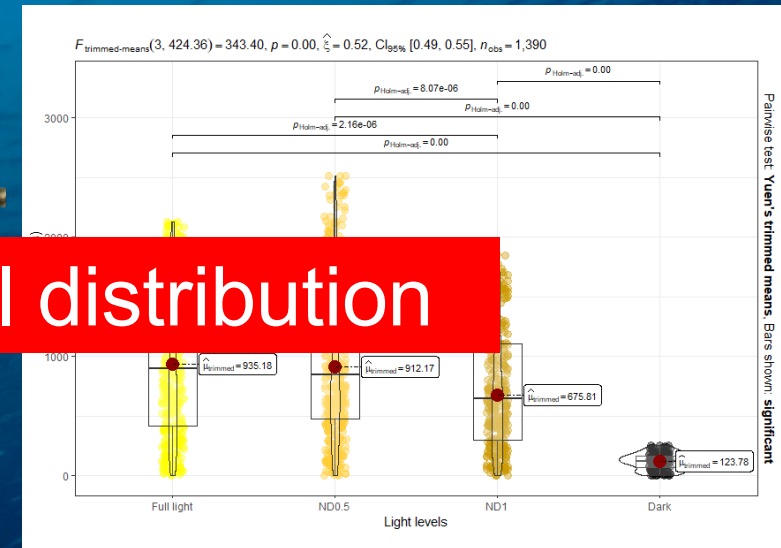
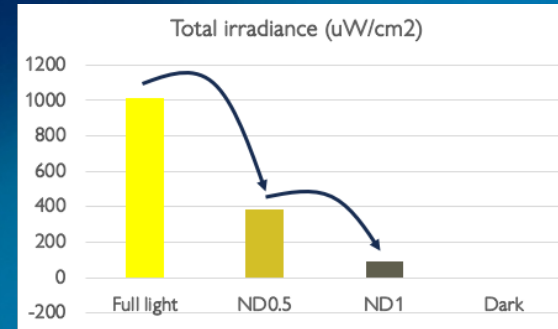
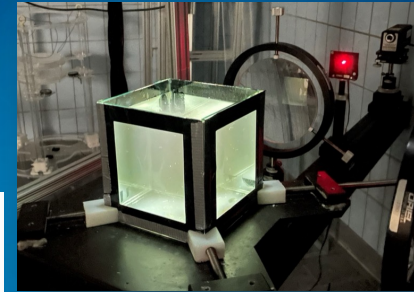


Important for vertical distribution

- Oil exposed less sensitive

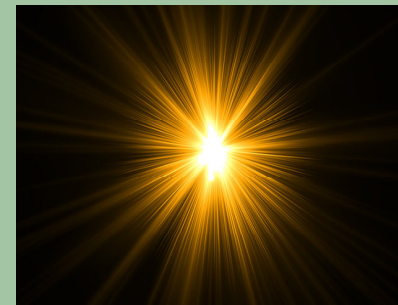
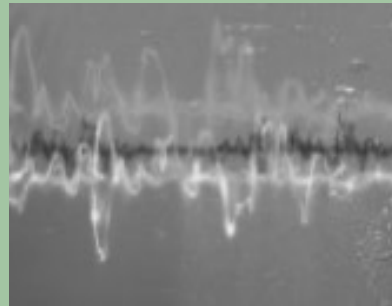
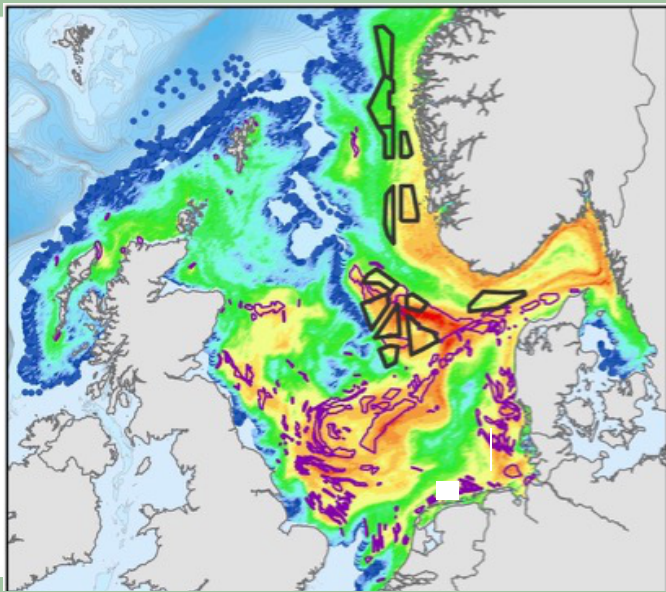


Durif et al. in prep

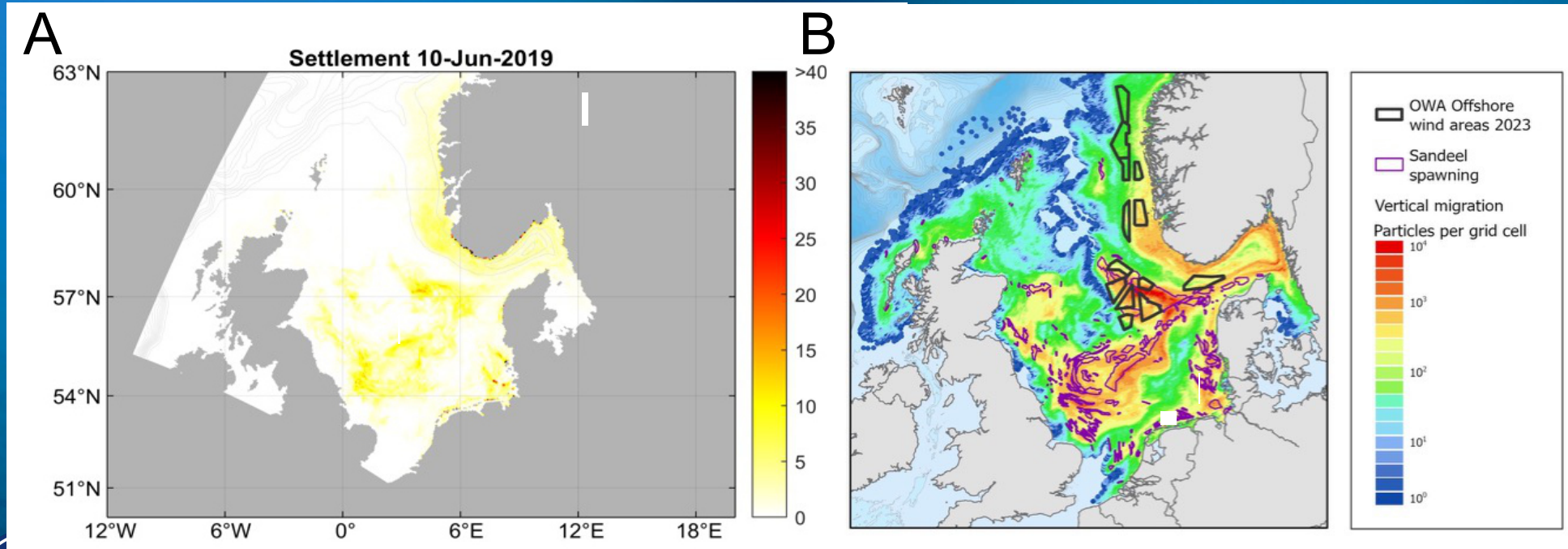


43 days old larvae

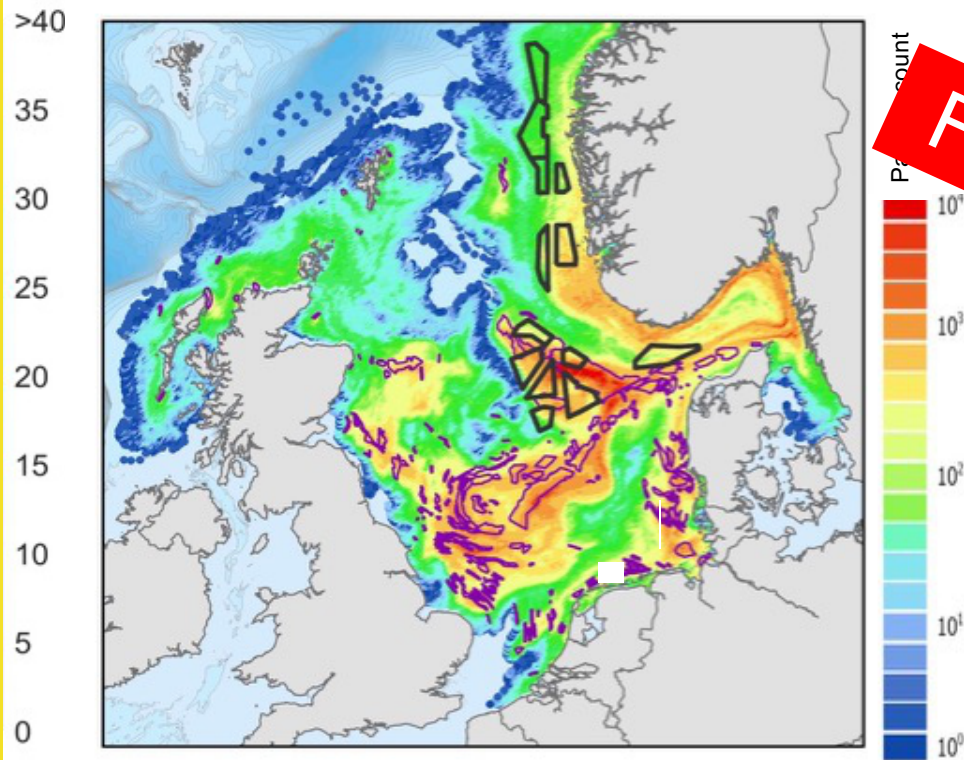
# Result: Knowledge-based risk assessment model



# From snap shot to future prediction



# GOAL: Operational larval drift model



Havvarsel

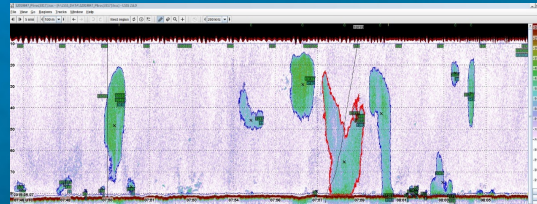
# In summary

## Knowledge from KnowSandeel:

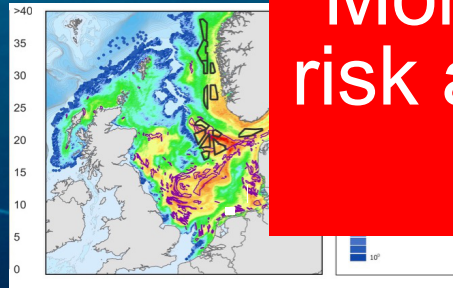
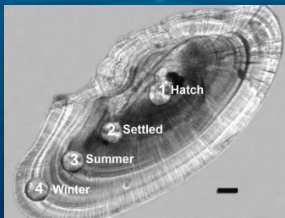
- Sensitivity to stressors



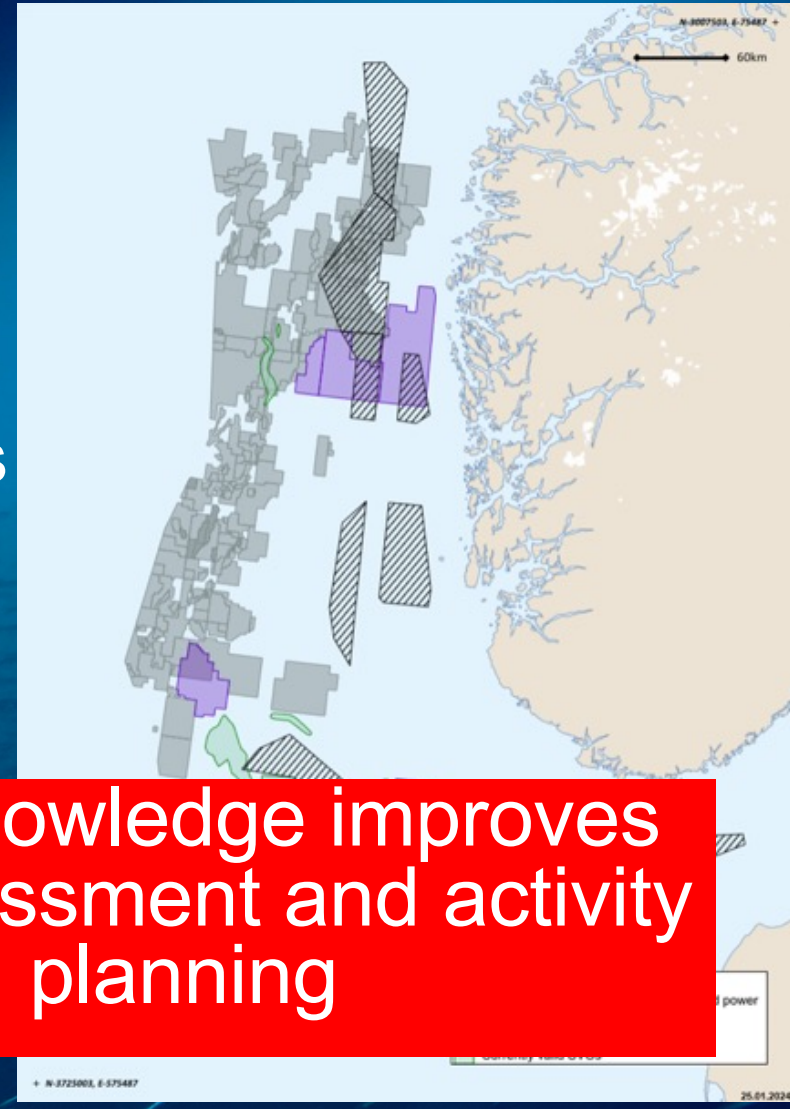
- Population structure and larvae densities



- Connectivity between areas and larval corridors

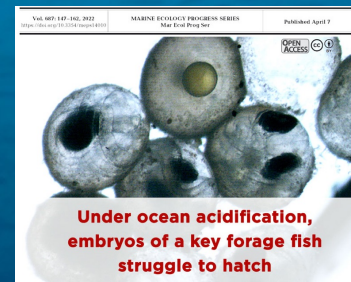


More knowledge improves risk assessment and activity planning

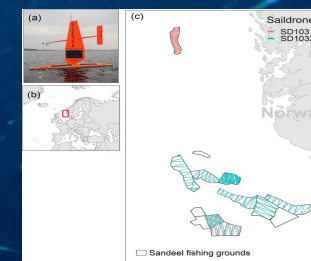
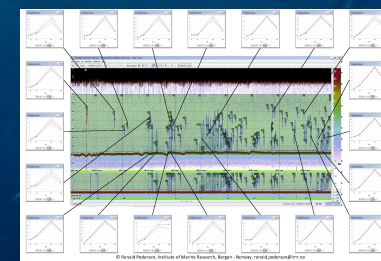
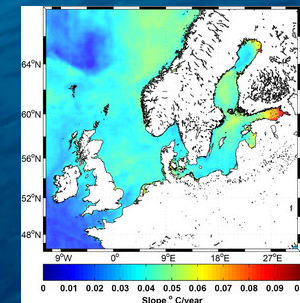


# Knowledge gaps and future projects

- How does stress factors affect the adult sandeel behavior?
- How does temperature and pH affect productivity?
- Acoustic data of larvae
  - Needs validation in controlled environment



Baumann et. al, 2022



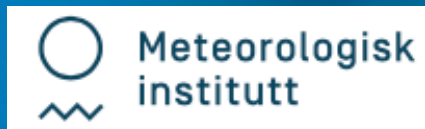
# Acknowledgements

## KnowSandeel project

Fisherman Geir Kenneth Eriksen



Elin Sørhus  
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Prescilla Perrichon  
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Håvard Frøysa  
Pål Næverlid Sævik



Kai Håkon Christensen  
Magne Simonsen  
Göran Broström



Industry partners:



**REPSOL**



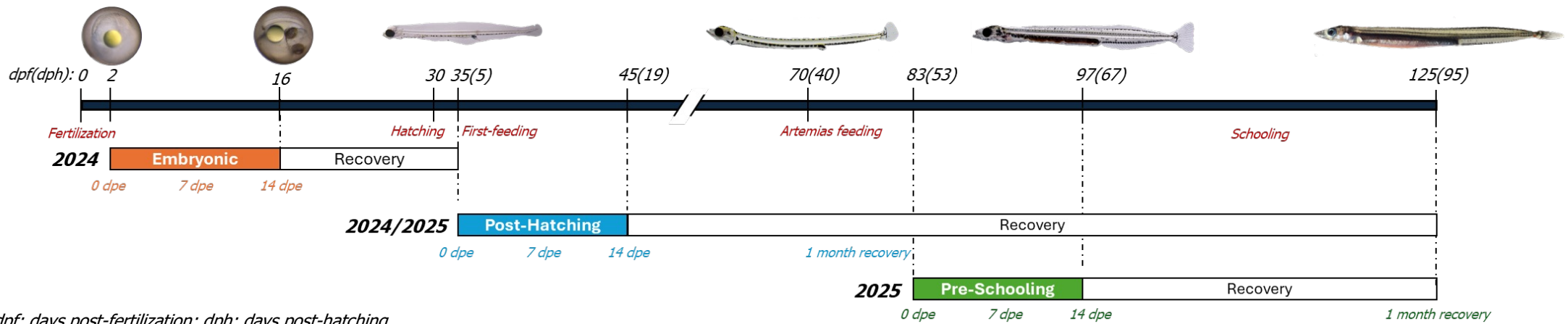
Thank you for  
your attention!



Photo: Erling Svensen



# EXPERIMENTAL DESIGN



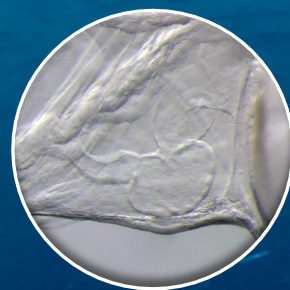
**Water chemistry**



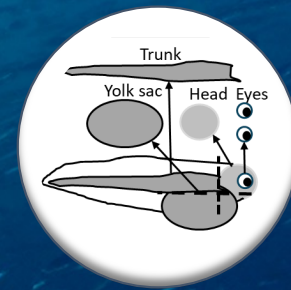
**Body burden  
cyp1a expression**



**Morphometry  
Morphology**



**Cardiac  
assessment**



**Vision/eye  
Lipidomic analysis**



**Survival**

# Data for risk assessment

Acute mortality  
Sublethal defects



Figure: Modified from Symbioses.no