



The project is funded by the European Maritime and Fisheries Fund and The Danish Fisheries Agency



# INTERNATIONAL INSTITUTE OF FISHERIES ECONOMICS & TRADE (IIFET)

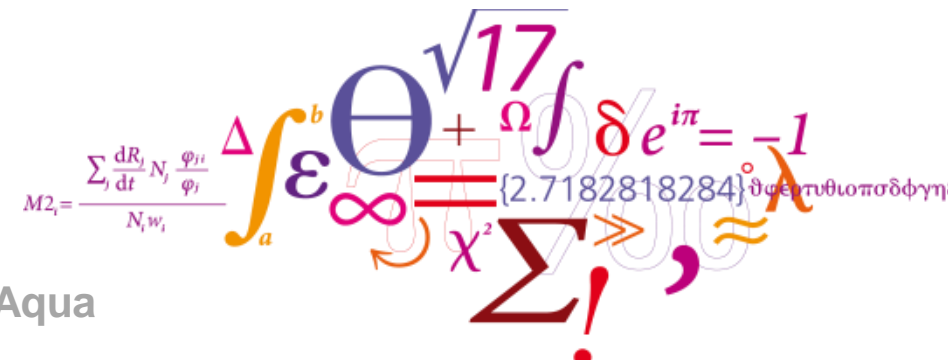
Coupling commercial fisheries and survey data:  
a practical solution to boost the amount of information in  
data-poor context

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DTU Aqua

National Institute of Aquatic Resources

Funding: MSPTOOLS, ECOAST, DTUAqua



- ▶ Data-poor species in fisheries science and their limitations
  - ↳ Do not follow most of the assumptions of the existing quantitative stock assessment models

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  - ↳ **Fishery-dependent data** (Commercial fisheries) } Different sampling designs -> bias

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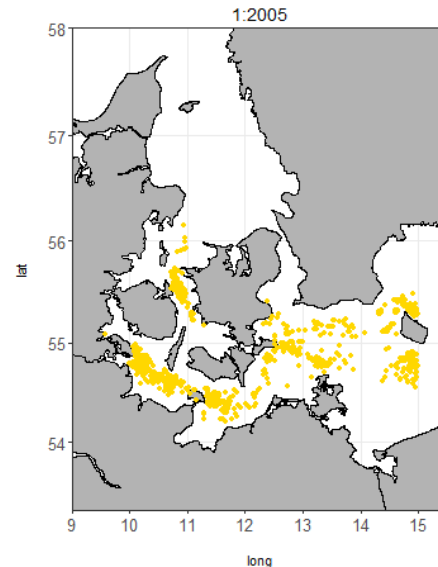
## Main objective

Develop a flexible and robust statistical model to estimate and predict species abundance in space and time

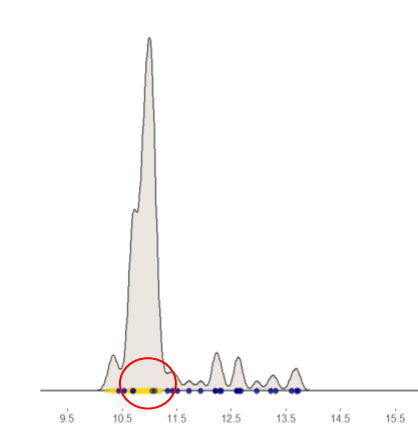
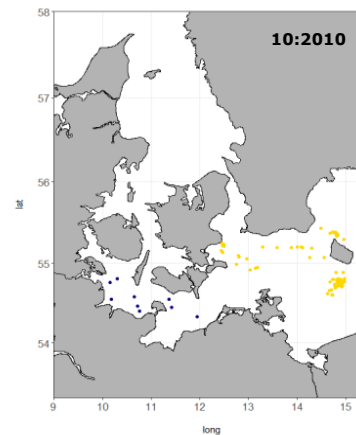
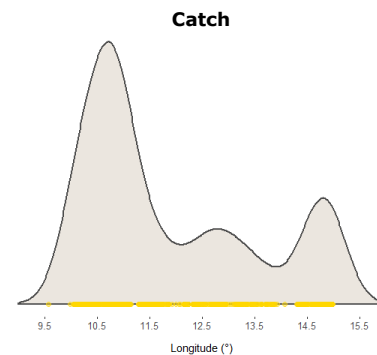
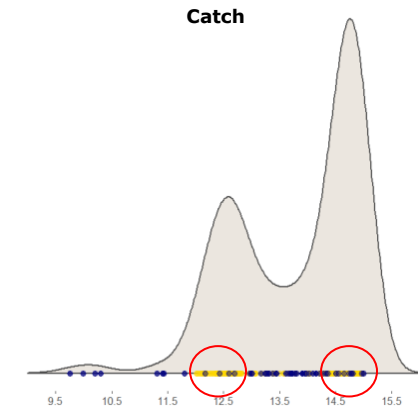
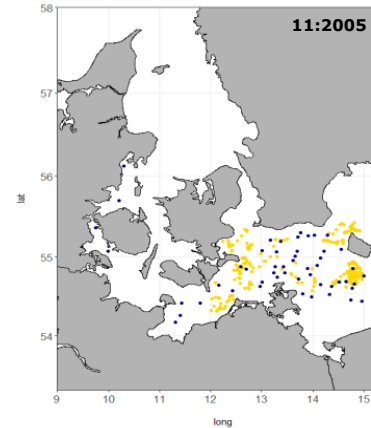
# Spatial & temporal sampling coverage

**Fishery dependent data:**  
Long time & short spatial coverage;

**Fishery-independent data:**  
Short time & long spatial coverage;



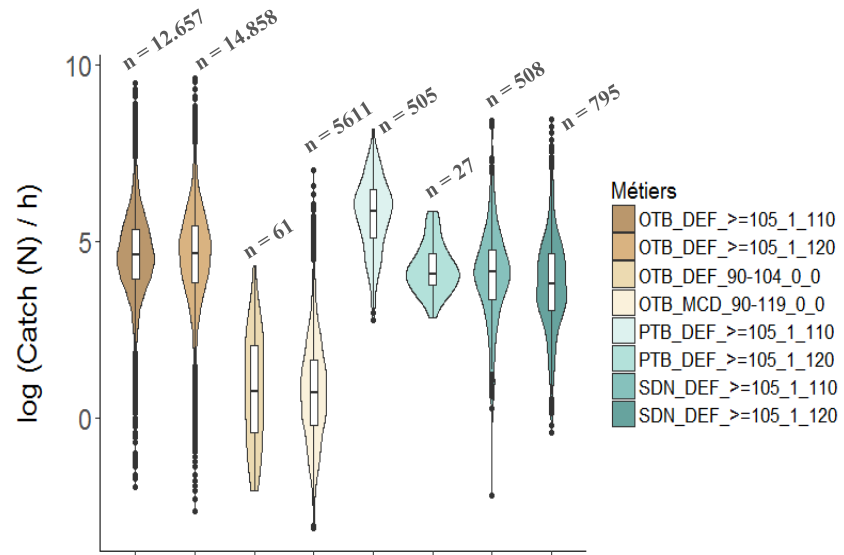
Data  
 • commercial  
 • survey  
 OTB\_DEF  
 OTB\_MCD  
 PTB\_DEF  
 SDN\_DEF



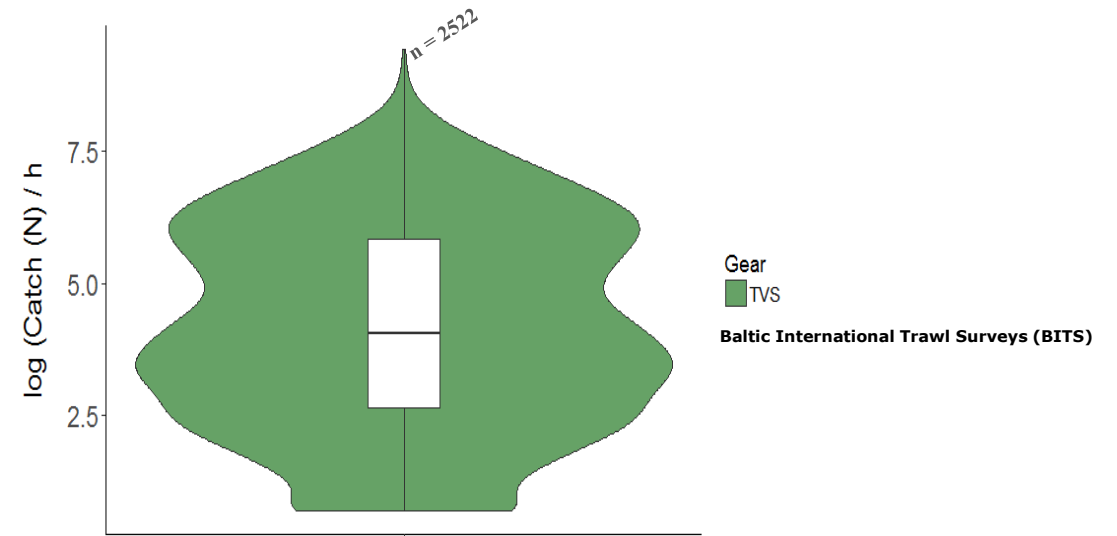
# Fishing catchability

Fishery-dependent data

Fishery-independent data



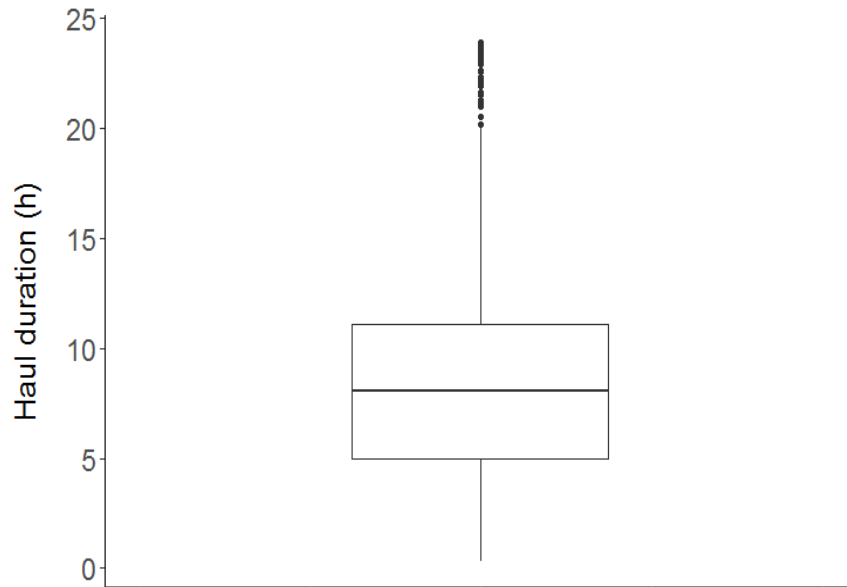
↑ Variability



↓ Variability

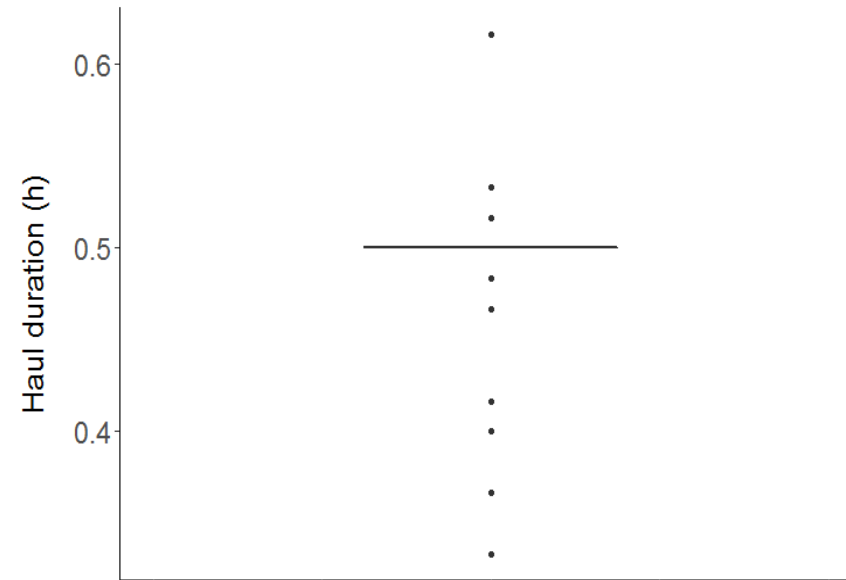
# Fishing effort

## Fishery-dependent data



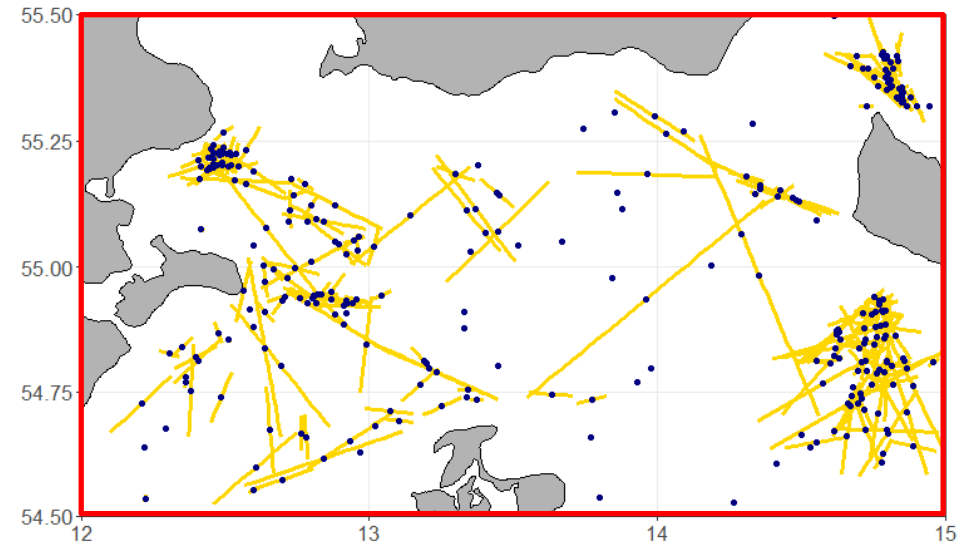
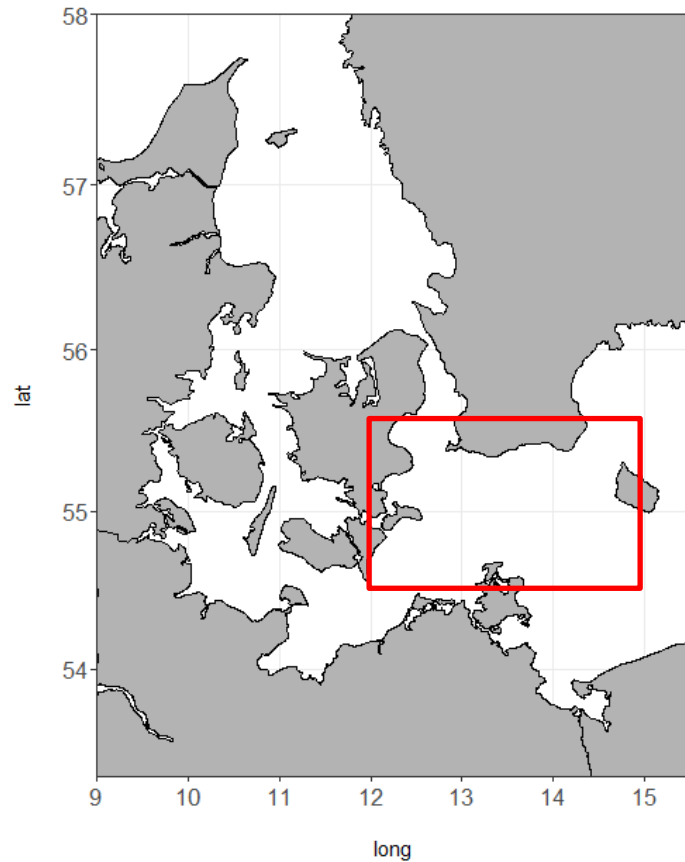
↑ Variability

## Fishery-independent data



↓ Variability

# Trawled distance





## Spatio-temporal model

$$d(\mathbf{s}, t) \sim NB(\lambda(\mathbf{s}, t), \phi)$$

$$\exp(\lambda(\mathbf{s}, t)) = \beta_0 + \gamma + \sum_{k=1}^{n_k} \beta_k \mathbf{x}_k(\mathbf{s}, t) + \sum_{l=1}^{n_l} \mathbf{f}_l(\mathbf{v}_l) + \xi(\mathbf{s}, t)$$

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Intercept

## Spatio-temporal model

$$d(s, t) \sim NB(\lambda(s, t), \phi)$$

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Offset (fishing effort)

## Spatio-temporal model

$$d(s, t) \sim NB(\lambda(s, t), \phi)$$

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Covariates (Depth, Sediment type and time of the year)

## Spatio-temporal model

$$d(s, t) \sim NB(\lambda(s, t), \phi)$$

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Random effect (Fishing catchability)

## Spatio-temporal model

$$d(\mathbf{s}, t) \sim NB(\lambda(\mathbf{s}, t), \phi)$$

$$\exp(\lambda(\mathbf{s}, t)) = \beta_0 + \gamma + \sum_{k=1}^{n_k} \beta_k \mathbf{x}_k(\mathbf{s}, t) + \sum_{l=1}^{n_l} \mathbf{f}_l(\mathbf{v}_l) + \xi(\mathbf{s}, t)$$

Spatio & temporal correlation

## Spatio-temporal model

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Response variable (N / age)



(count data)

## Spatio-temporal model

### Option 1

**Fishery-dependent data**

- OBO (On-board observer)
- DFAD (Danish fisheries analysis database)
- VMS (Vessel monitoring system)
- Vessel logbook

### Option 2

**Fishery-independent data**

- BITS (Baltic International Trawl Surveys)
- IBTS (International Bottom Trawl Surveys)

### Option 3

**Fishery-dependent +  
independent data**



# Spatio-temporal model

## Cod



*Gadus morhua*

( SD 21  
SD 22-24 )

## Sprat



( SD 22-24 )

## Herring



*Clupea harengus*

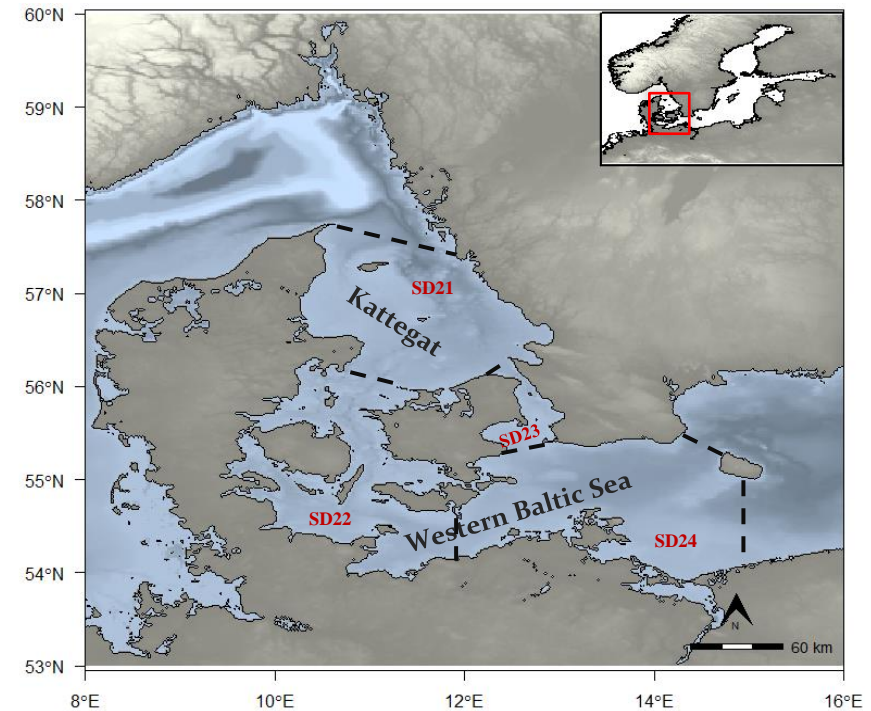
( SD 21-24 )

## Plaice



*Pleuronectes platessa*

( SD 21-23  
SD 24-32 )



\*SD = ICES subdivision

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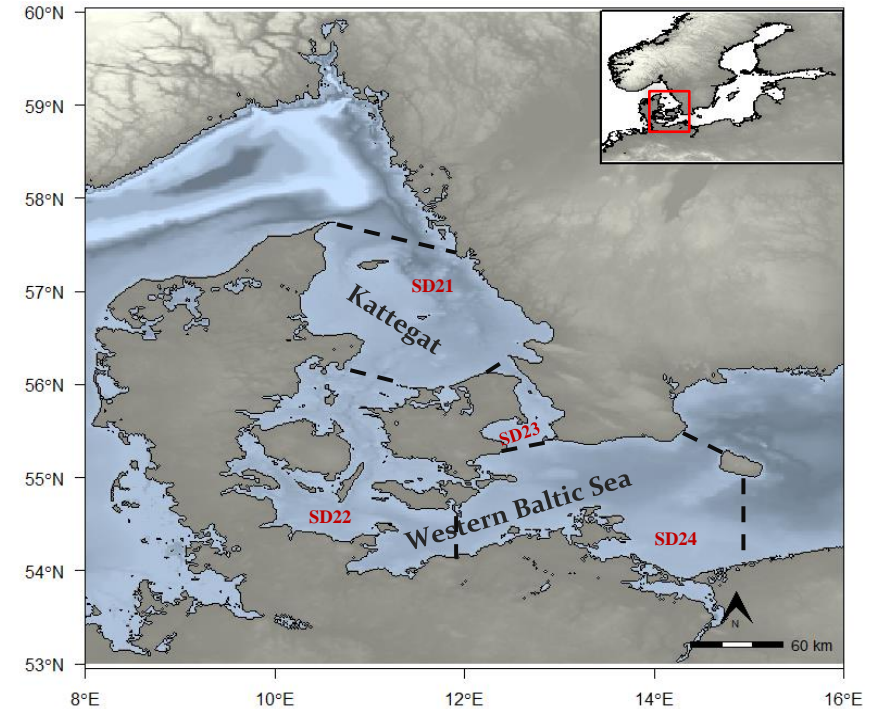
( SD 21-24 )

**Plaice**



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SD 24-32 )



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	Model	AIC		
		Commercial	Survey	Both
m1	Time	392280.9	5240.1	397808.8
m2	Time + Depth	392174.4	5009.1	397634.4
m3	Time + Depth <sup>2</sup>	392140.9	5019.1	397588.3
m4	Time + Sediment	392295.0	5264.0	397822.0
m5	Time + Depth + Sediment	392148.3	5035.0	397592.8
m6	Time + Depth <sup>2</sup> + Sediment	392089.4	5044.9	397515.7
m7	Time + Depth:Sediment	392170.1	5060.9	397604.4

- Different results according to the input data ;
- Combined model is driven by the dataset containing the highest amount of data;

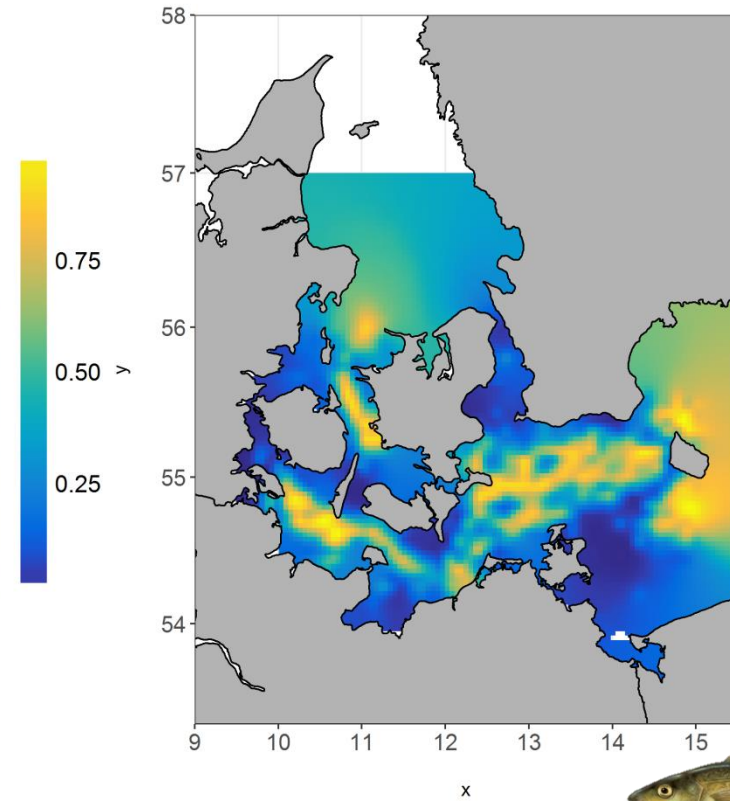
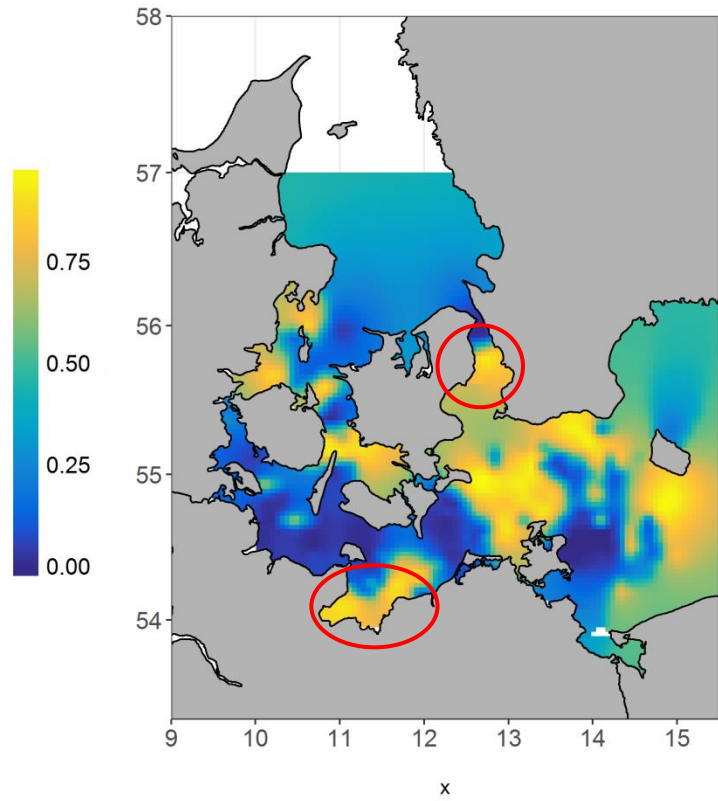
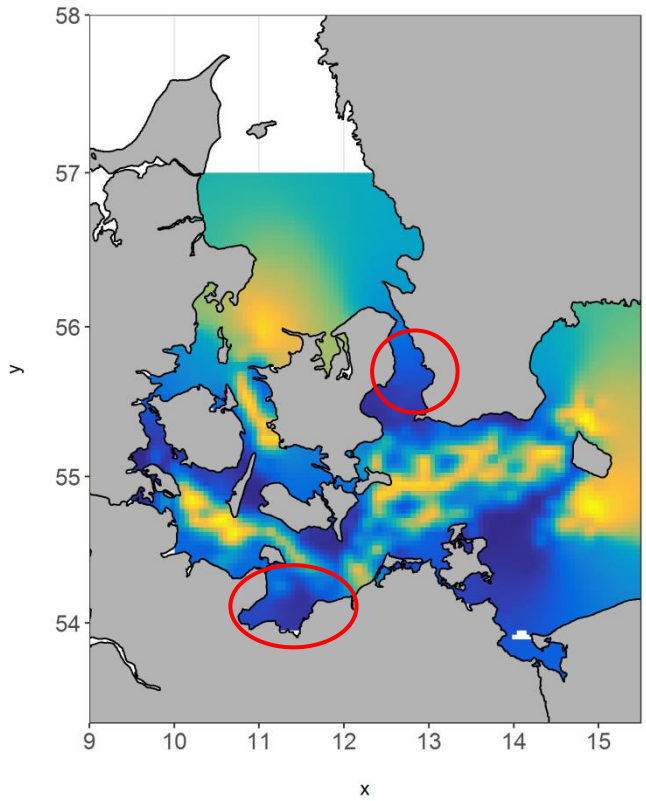


**Cod (SD22-24)**

### Commercial (option 1)

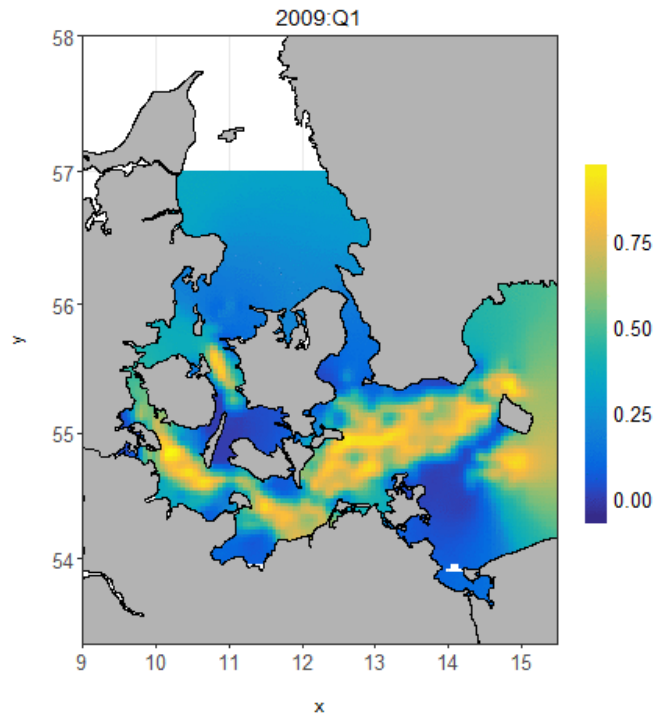
### Survey (option 2)

### Combined (option 3)

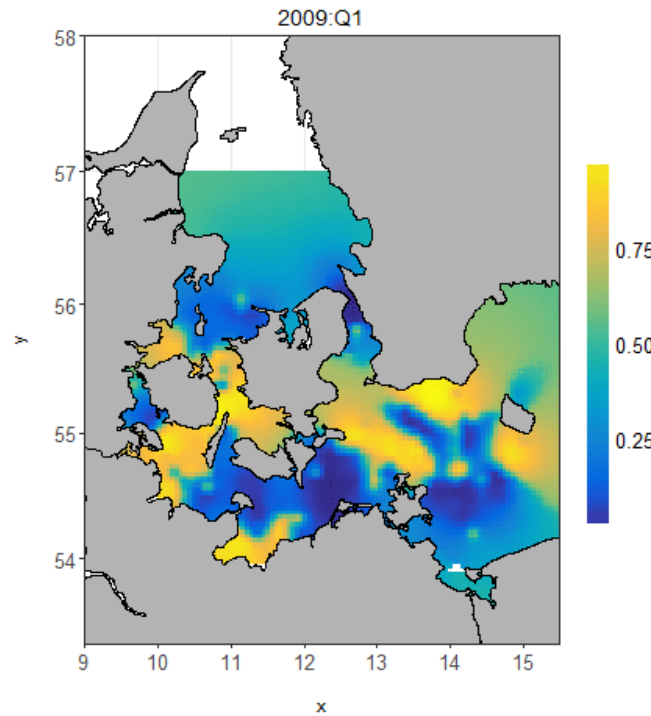


**Cod (SD22-24)**

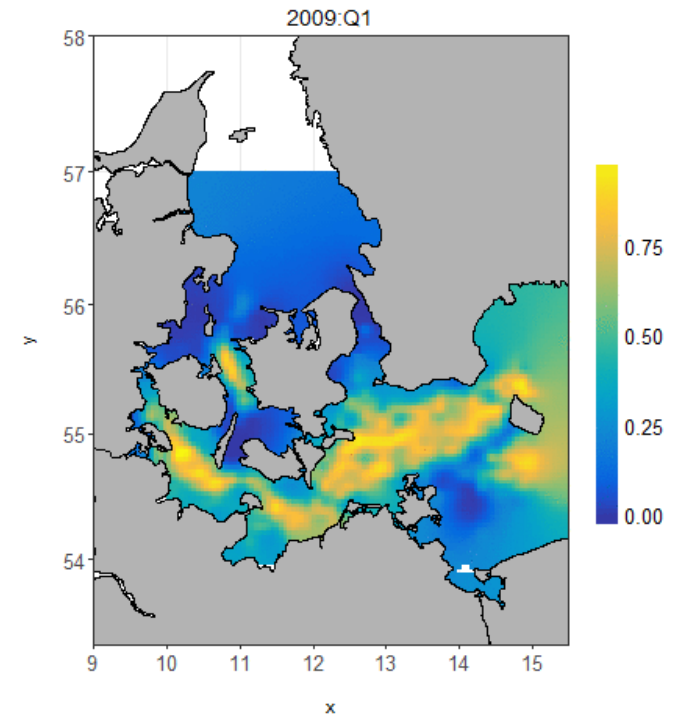
### Commercial (option 1)



### Survey (option 2)



### Combined (option 3)



**Cod (SD22-24)**



DISPLACE

File Graph Graph Editor Parameters Model Utilities Windows

Model Objects

- [1] simu1
  - Environmental Forcing
  - Monthly Output Layers
    - Abundance (PopValues TotalN)
    - Biomass (PopValues TotalW)
    - Impact ((PopValues Impact)
    - Catches Per Pop (PopValues CumCatches)
    - Benthos Biomass (FuncGroups bNTot)
    - Benthos Number (FuncGroups bB)
    - Benthos Mean Weight (FuncGroups bMeanW)
    - Fishing Effort (NodesStat CumFTime)
    - Swept Area (NodesStat CumSwA)
    - Subsurface Swept Area (NodesStat CumSubSurfSwA)
    - Catches (NodesStat CumCatches)
    - Catches With 70% Threshold (NodesStat CumCathesThrsld)
    - Discards (NodesStat CumDiscards)
    - Discards Ratio (NodesStat CumDiscardsRatio)
  - Monthly Fishing Tariffs
  - Nodes
  - Fish Populations

Statistics

Populations Nations Vessels Harbours Metiers

Cum. Gross Added Value - Energy Costs only

Pos: 56.0405 7.71916

Used memory: 1376Mb Peak: 1527Mb

Commands

- Start
- Stop
- Setup

Simulation Status

Simulation step:

Playback

43823/43823

D 1825 [sat] Wk 260  
Mt 59 Yr 4  
23:00 h

[www.displace-project.org](http://www.displace-project.org)

**Thank you!**