



# Spatial protection of the Kattegat cod stock

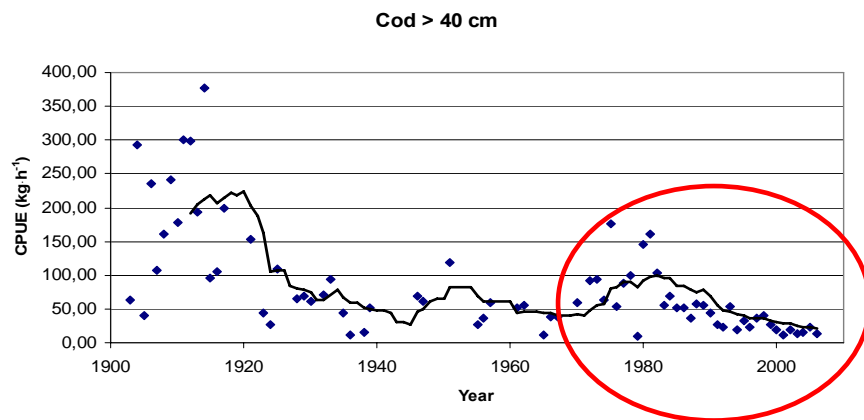


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Institute of Marine Research, Swedish Board of Fisheries*

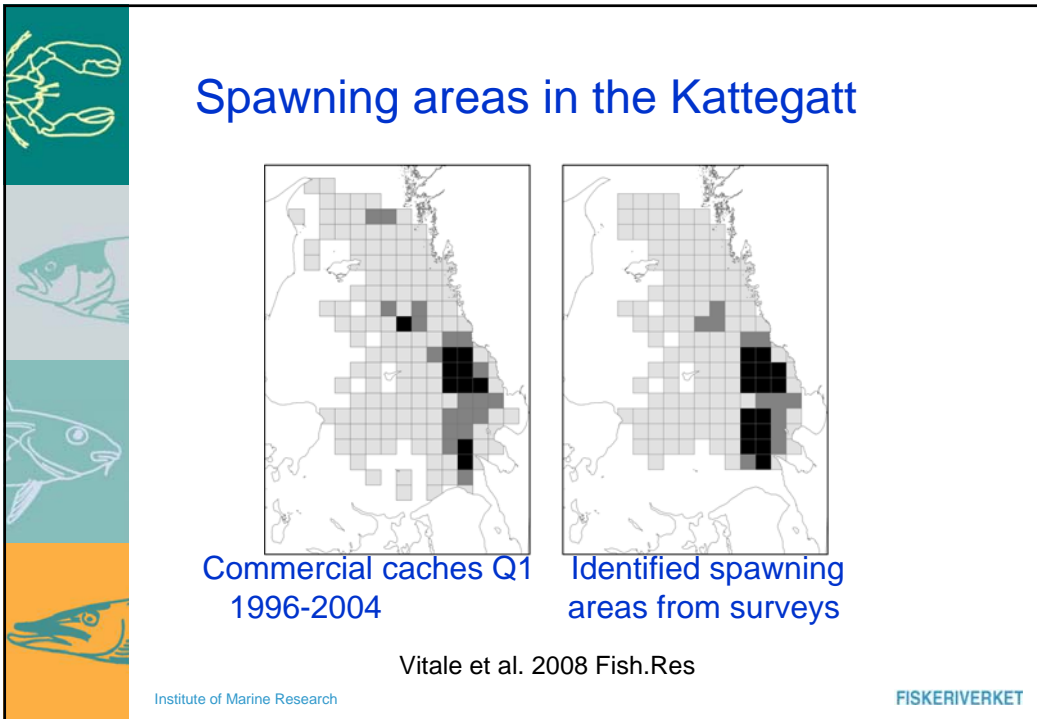
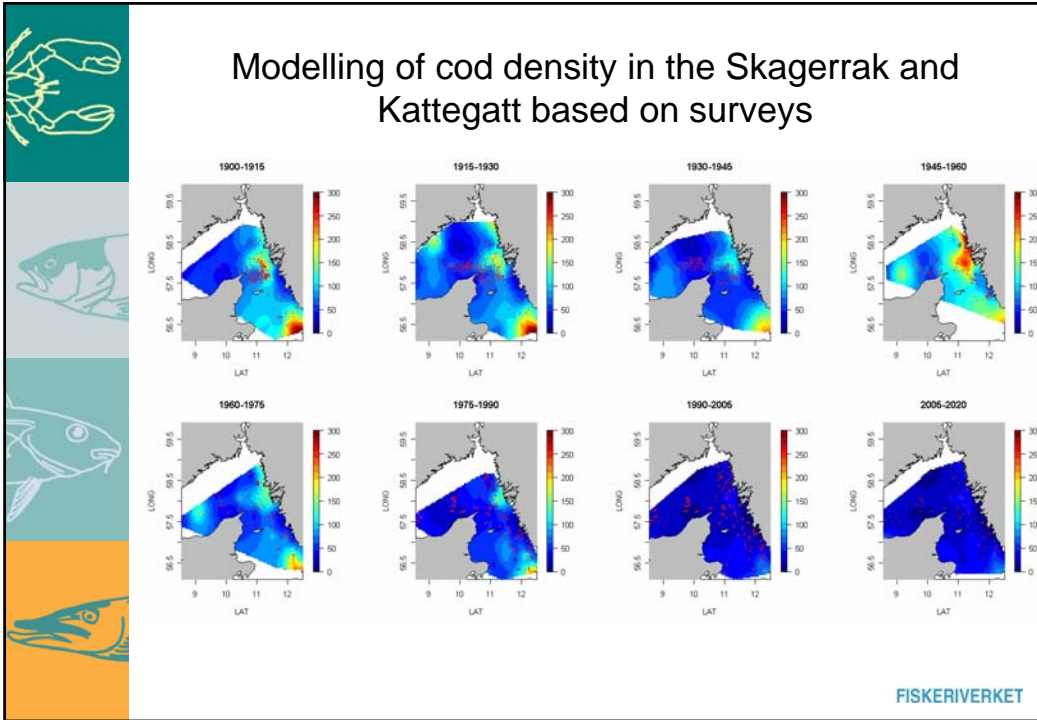
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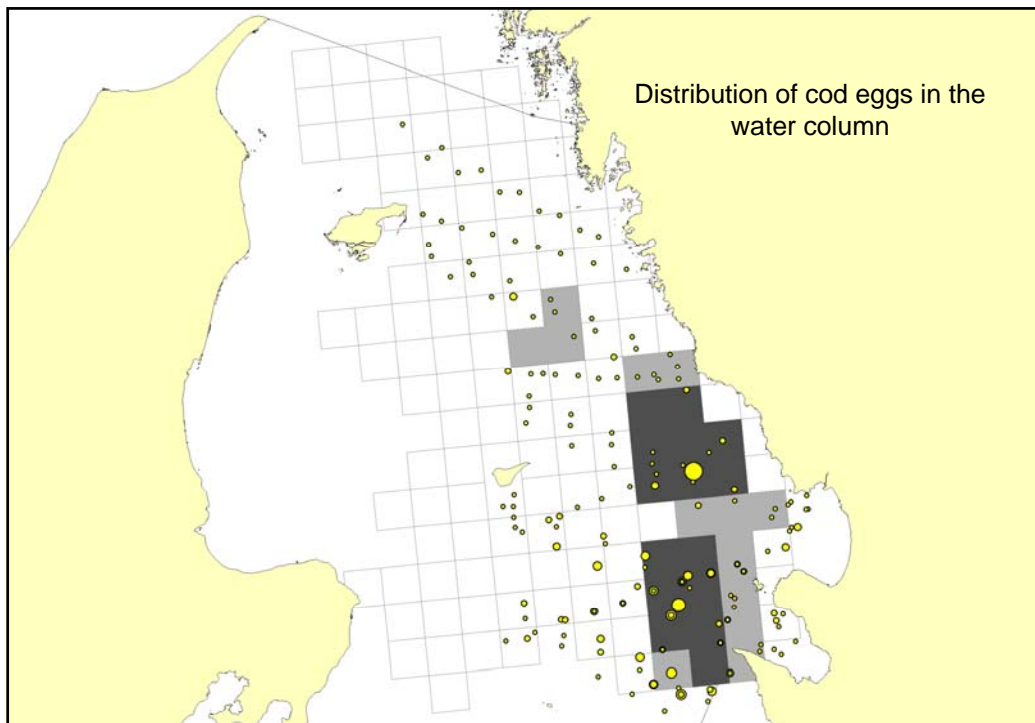






# Survey catch per unit effort of cod in the Kattegat and Skagerrak from a historical perspective



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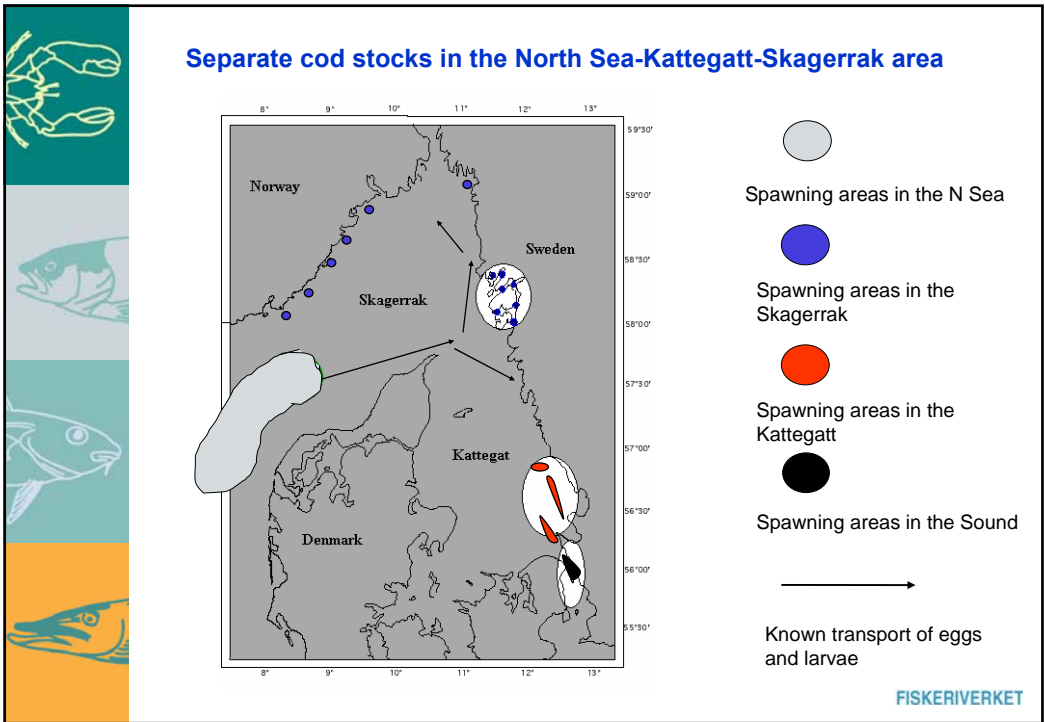
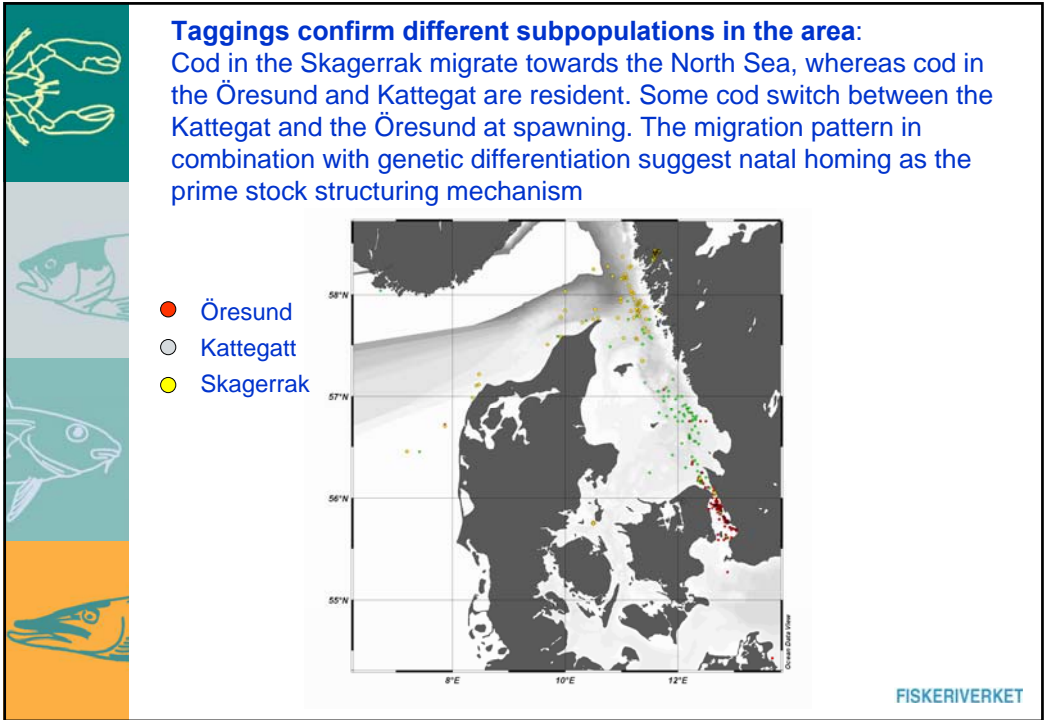





## Evidence of genetic differentiation:

The Kattegat stock differs from local populations in the Skagerrak and from the North Sea cod stock

$F_{ST} / P$	Kattegat	Gullmar	North Sea
Kattegat	-	0.0049	0.0000
Gullmar	0.0017	-	0.0087
North Sea	0.0043	0.0021	-

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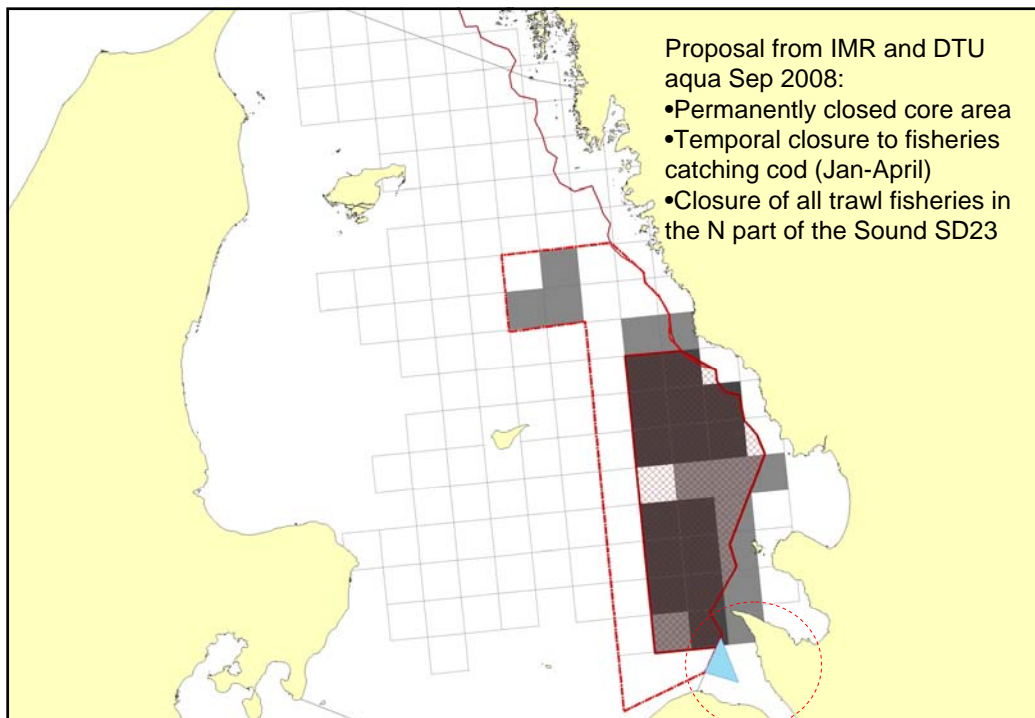


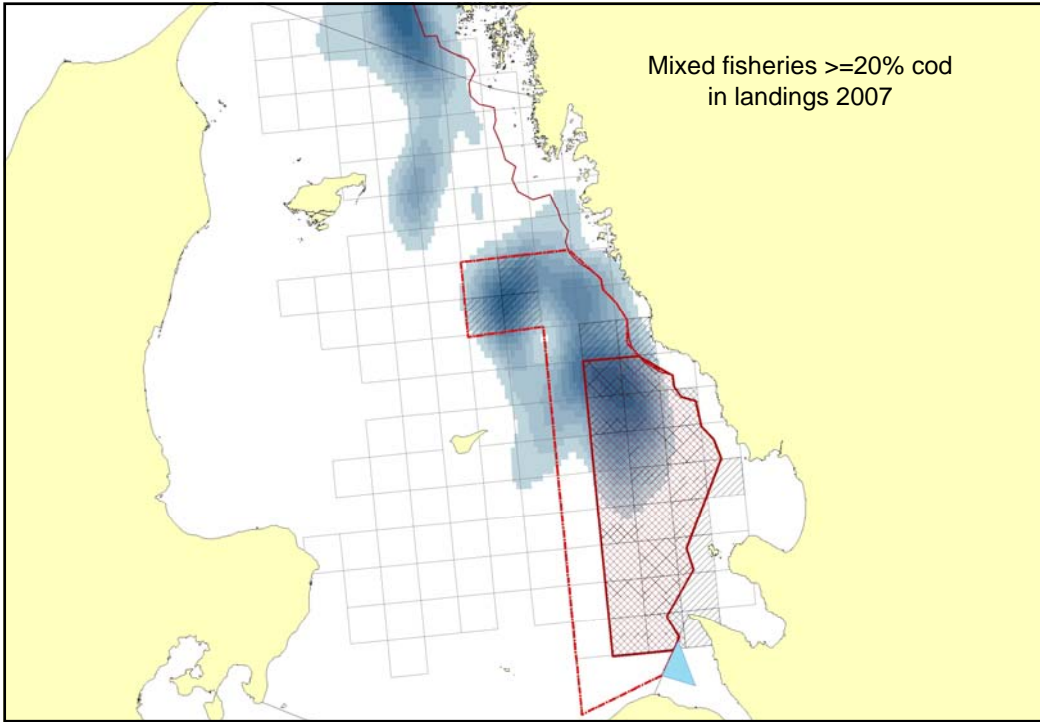
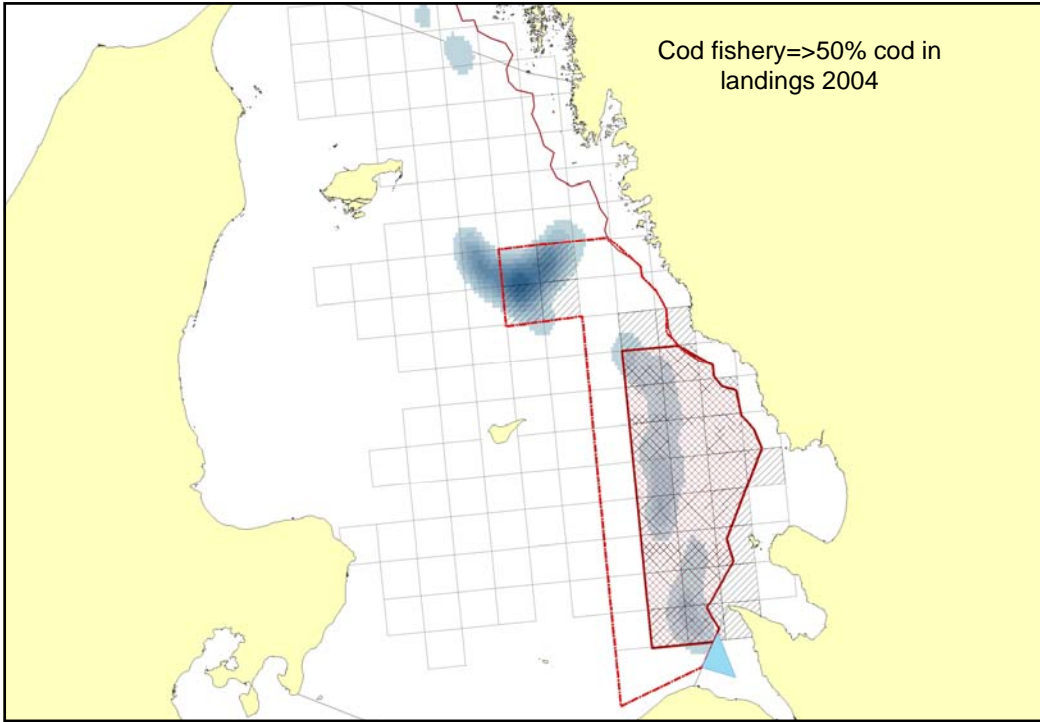


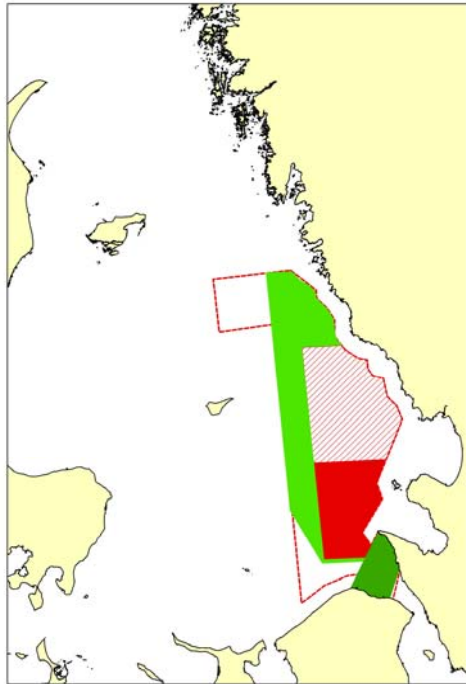
## Summary

- The Kattegat population is separate from the North Sea, Skagerrak and the Baltic
- The Kattegat population have limited migration
- Inflow of recruits may mask impaired recruitment
- The population has decreased substantially since the 1970:s
- Very high fishing mortality
- Very few older individuals
- Impaired recruitment, especially in the south where spawning takes place

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## Kattegatt

Rött område=>permanent stängt område för allt fiske

Streckat område=>permanent stängt område för torskfiske. Icke torskfångande redskap tillåtna (burfiske efter kräfta hela året, trålfiske efter kräfta med rist 1 april-31 december)

Grönt område=>Säsongsstängt område för torskfiske (1 januari-31 mars, 1 februari i Öresund). Icke torskfångande redskap tillåtna hela året

*Yttre streckad linje motsvarar den avgränsning som svenska och danska forskare föreslog. Som säsongsstängt område. Forskarnas förslag innebär också att även det streckadeområdet skulle vara permanent stängt för allt fiske.*

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## Acoustic survey

Acoustic methods have several advantages:

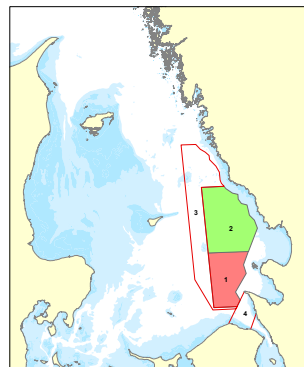
- Can be used in all kinds of habitats
- Provide continuous measures of abundance
- Find fish anywhere in the water column
- Is non-invasive

Drawbacks

- No species information (although size may be used as a proxy)
- No biological information (e.g. age, sex or maturity class)

Solution

- Combine abundance from acoustics with species size distribution from the Fishermen survey



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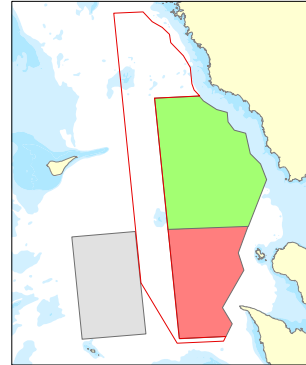


## Survey Design

Survey area  
Closed area  
Seasonally closed area  
Reference area

Survey period  
October-November 2009 – 2011 (concurrent with Fishermen survey)

Equipment  
R/V Mimer  
Simrad EK60 120 kHz split-beam echo sounder with a 7° composite transducer



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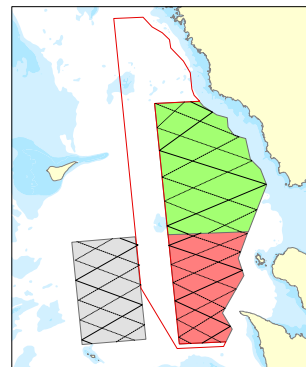
## Pilot study 2009

The survey was designed as a systematic ziq-zaq line sampling with random starting point with approximately equal effort in each area.

3 nights dedicated to each survey area

Survey speed was 4 knots

Total transect length in 2009 ranged from 120 - 160 nautical miles per area



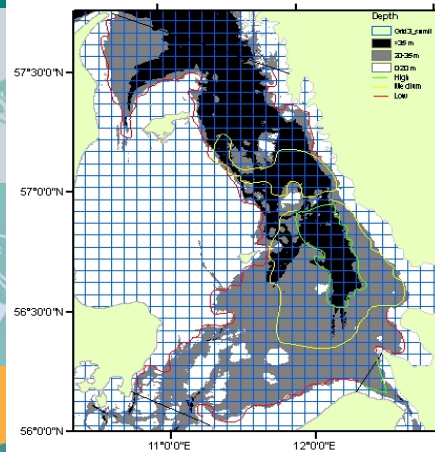
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# Fisherman survey in Kattegatt

Johan Lövgren



## Desian



- Four trawlers (DK,SE)
- 70 mm trawl (0+ cod ,10-15 cm)
- 20 stations/vessel
- 6 "high" (green)
- 8 "intermediate" (yellow)
- 6 "low" (red)
- 1 hour haul time





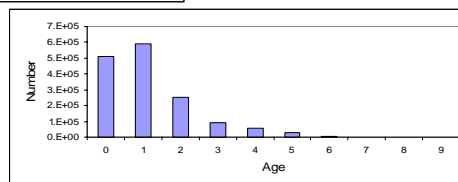
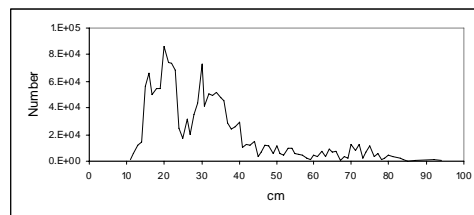
## Results 2008

Area	Kg COD/trawl hour
High	28.3
Medium	11.1
Low	4.0

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## Numbers of fish

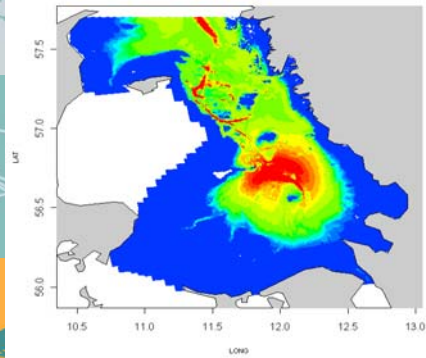


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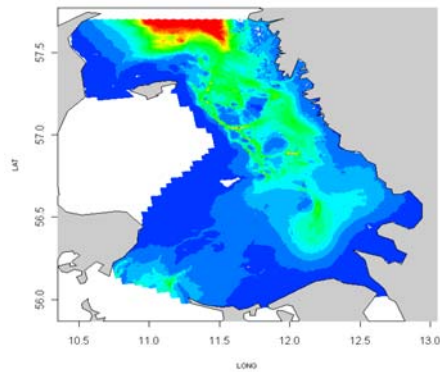


# Spatial distribution 2008

Above 39 cm



Below 39 cm



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# SSB estimates 2008

SSB ICES :1400-3400 ton  
SSB Survey :max 1600 ton



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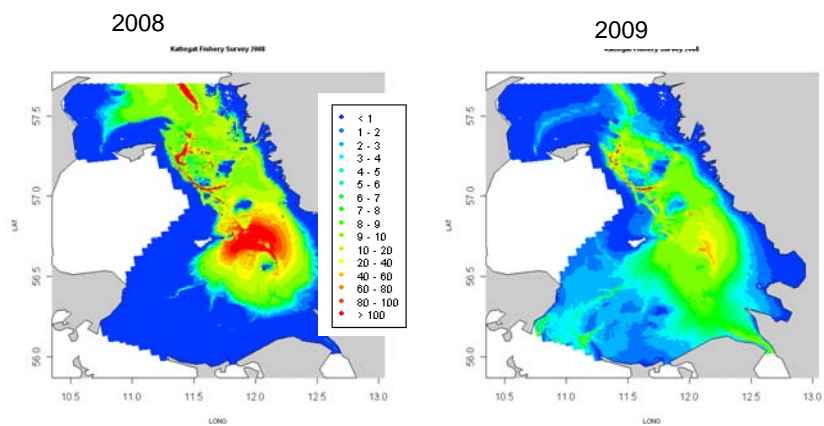
## 2008 -2009 Preliminary results

	2008	2009
Cod #:	1100	1600
Cod kg:	1169	676

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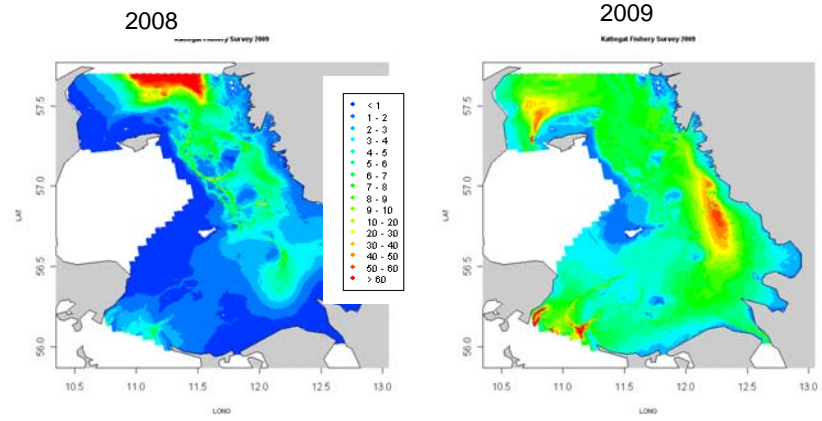
## Cod above 39 cm



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# Cod under 39 cm



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