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# Life-history strategies and population dynamics of Northern krill

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# Outline

- Short background on Northern krill (*Meganyctiphanes norvegica*)
- About the model and modelling approach
- Results
- The road ahead

# Northern krill

- Found in most parts of the North Atlantic
- Forage on both zooplankton and phytoplankton
- Known to display classic diel vertical migration
- Lifespan of 2-3 years
- Adults grow to a length of 45mm

# Vertical migration and distribution

- Descends at dawn and ascends at dusk
- The range of its vertical migration is based on light conditions, predator density, moulting cycle and others factors

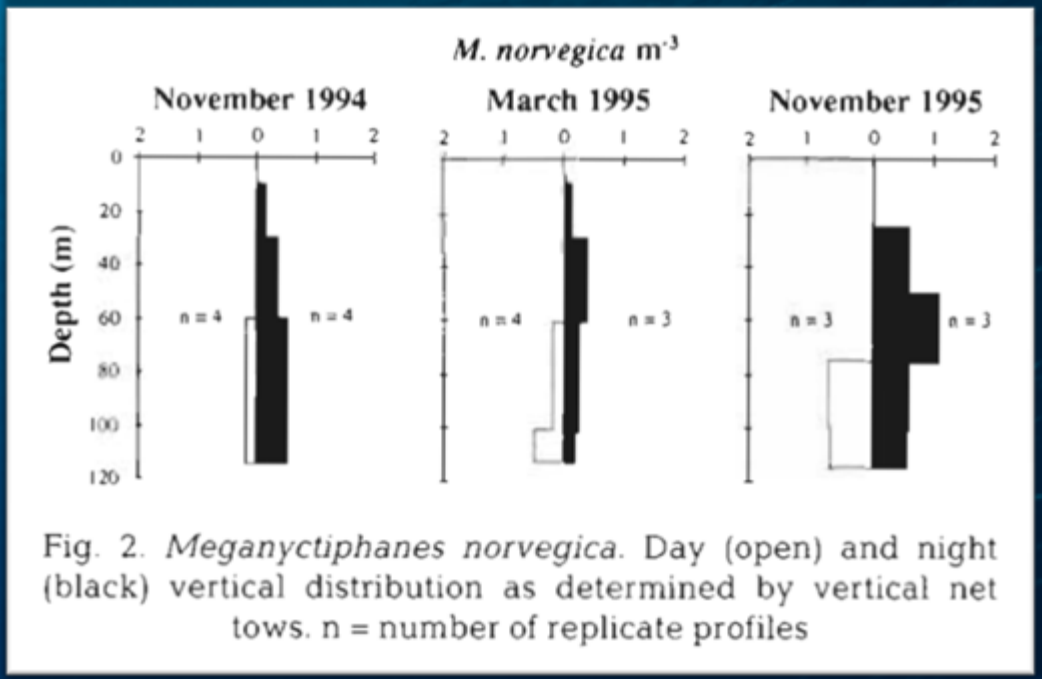
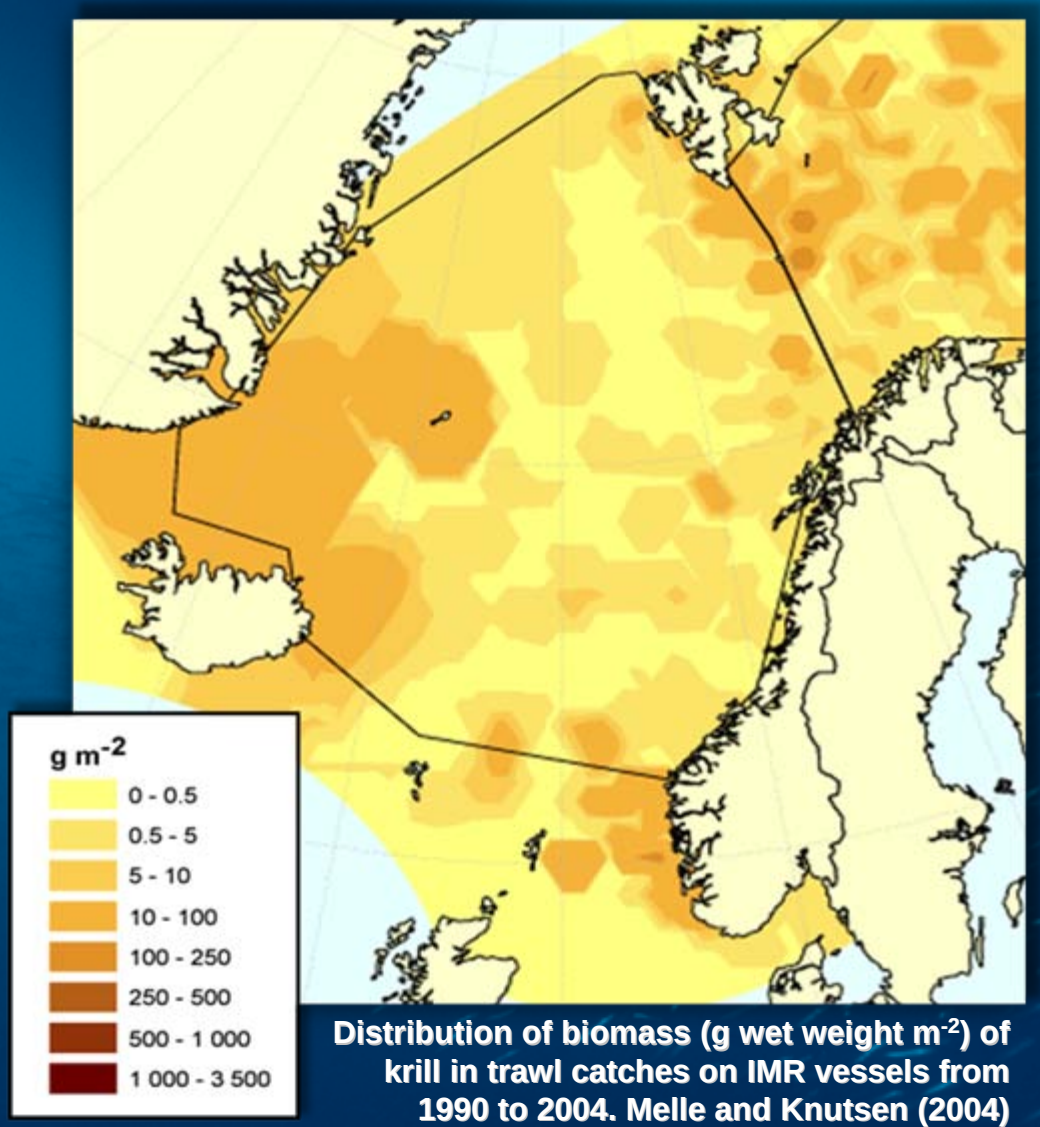



Fig. 2. *Meganyctiphanes norvegica*. Day (open) and night (black) vertical distribution as determined by vertical net tows. n = number of replicate profiles

Onsrud & Kaartvedt, MEPS 1998

# Norwegian Sea distribution

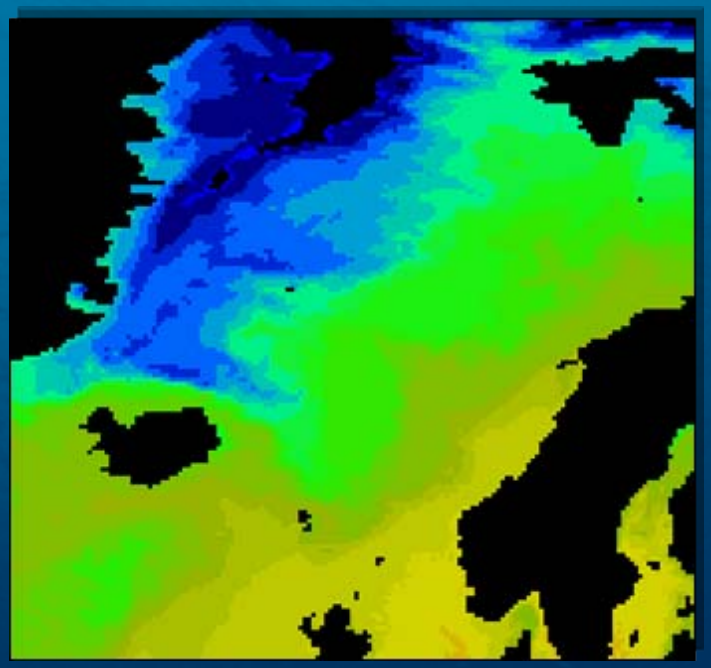
- Total euphausiid biomass estimated to 42 million tonnes (Melle *et al* 2004)
- *M. norvegica* is estimated to account for 40%-75% of the euphausiid biomass (Lindley 1982)



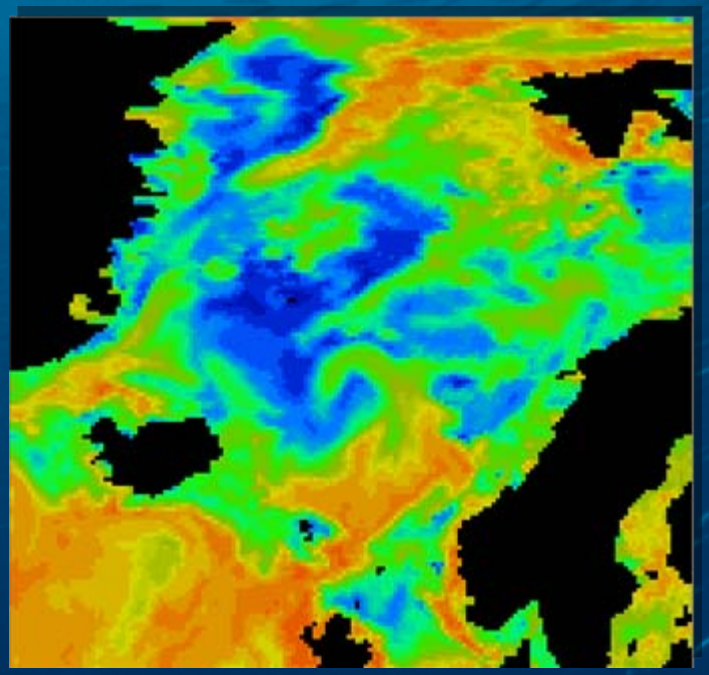

**Distribution of biomass (g wet weight $m^{-2}$) of krill in trawl catches on IMR vessels from 1990 to 2004. Melle and Knutsen (2004)**

# About the model

- An individual-based simulation model
- External forcing from ROMS on a 20x20 km grid (temperature, phytoplankton, currents)



Temperature field at Julian day 230



Phytoplankton field at Julian day 132

# The individuals

- Each individual has two unique vectors:
- Attribute vector containing all individual attributes
  - Individual number
  - Structural and fat weight
  - Age
  - Eggs laid
  - ... and many more
- Strategy vector containing life-history traits
  - First and last spawn day
  - Day and night depth
  - Light level to change from day <-> night depth

# Processes

- Movement – drift and vertical migration
- Growth
  - Foraging on zooplankton and phytoplankton
  - Respiration
- Mortality
  - Tactile and visual predators
- Reproduction


**spawner**



**egg/offspring**



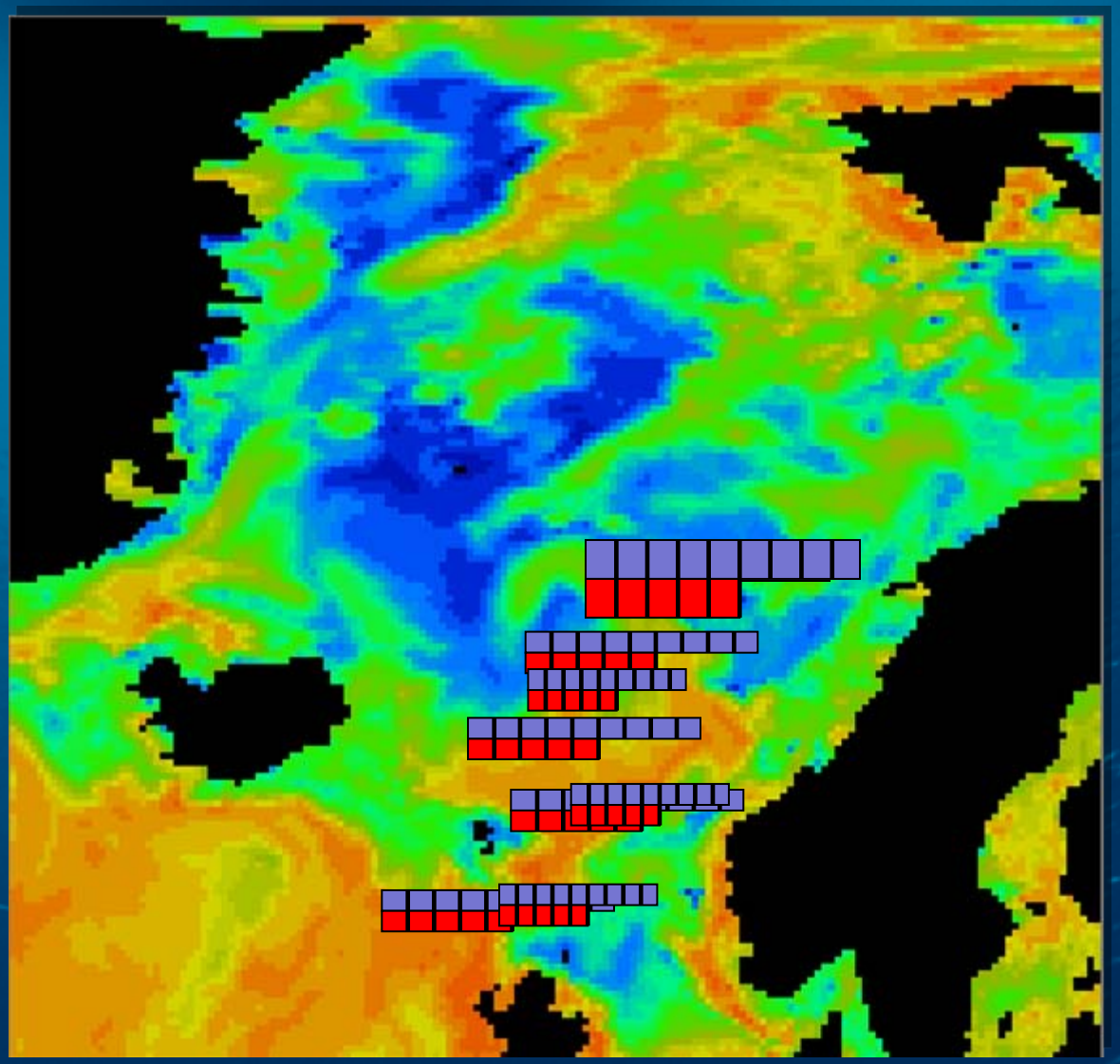
# Model summary

**Environment:**
- Temperature
- Currents
- Phytoplankton
- Zooplankton

**Individuals:**
- Drift
- Vertical migration

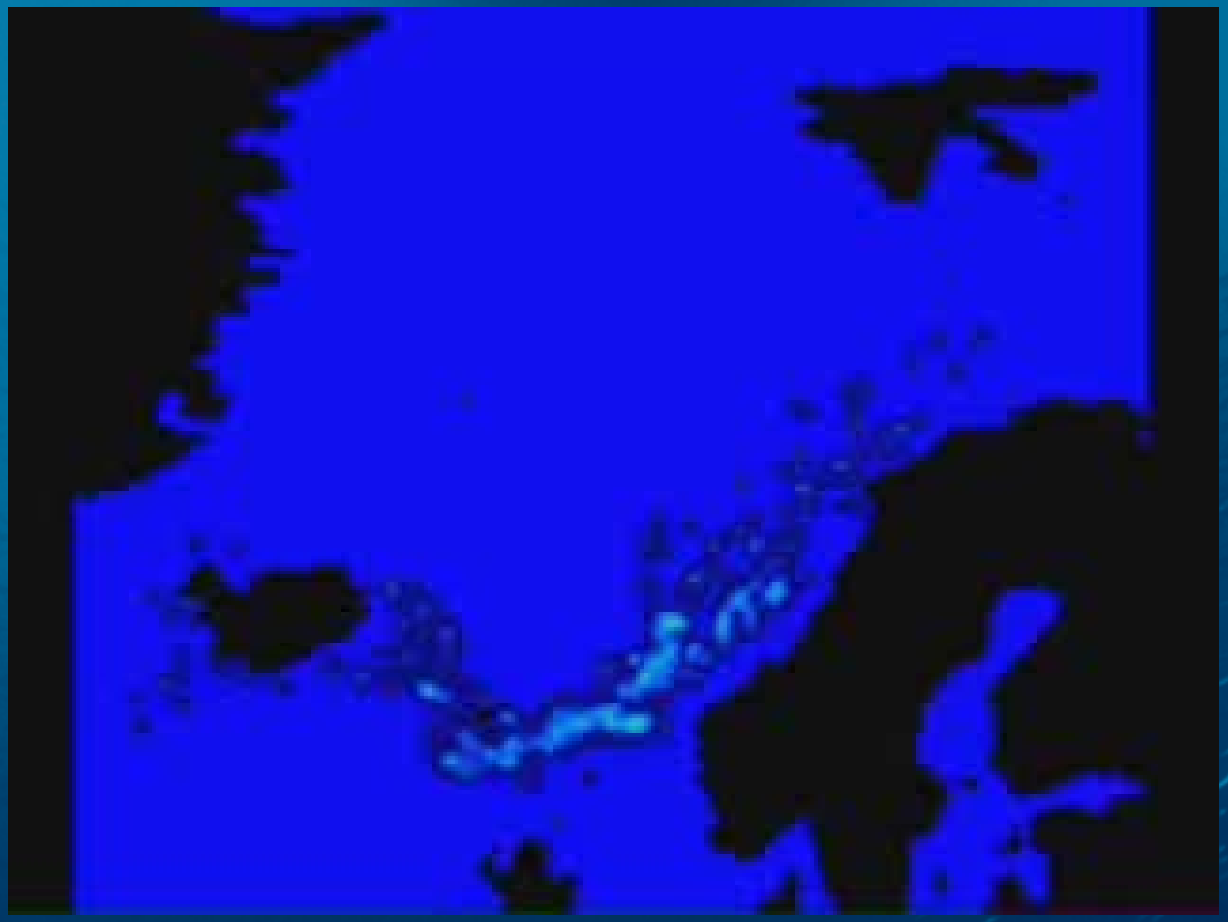
- Forage
- Grow
- Die

- Reproduce



# Results

- Distribution: No age limitation

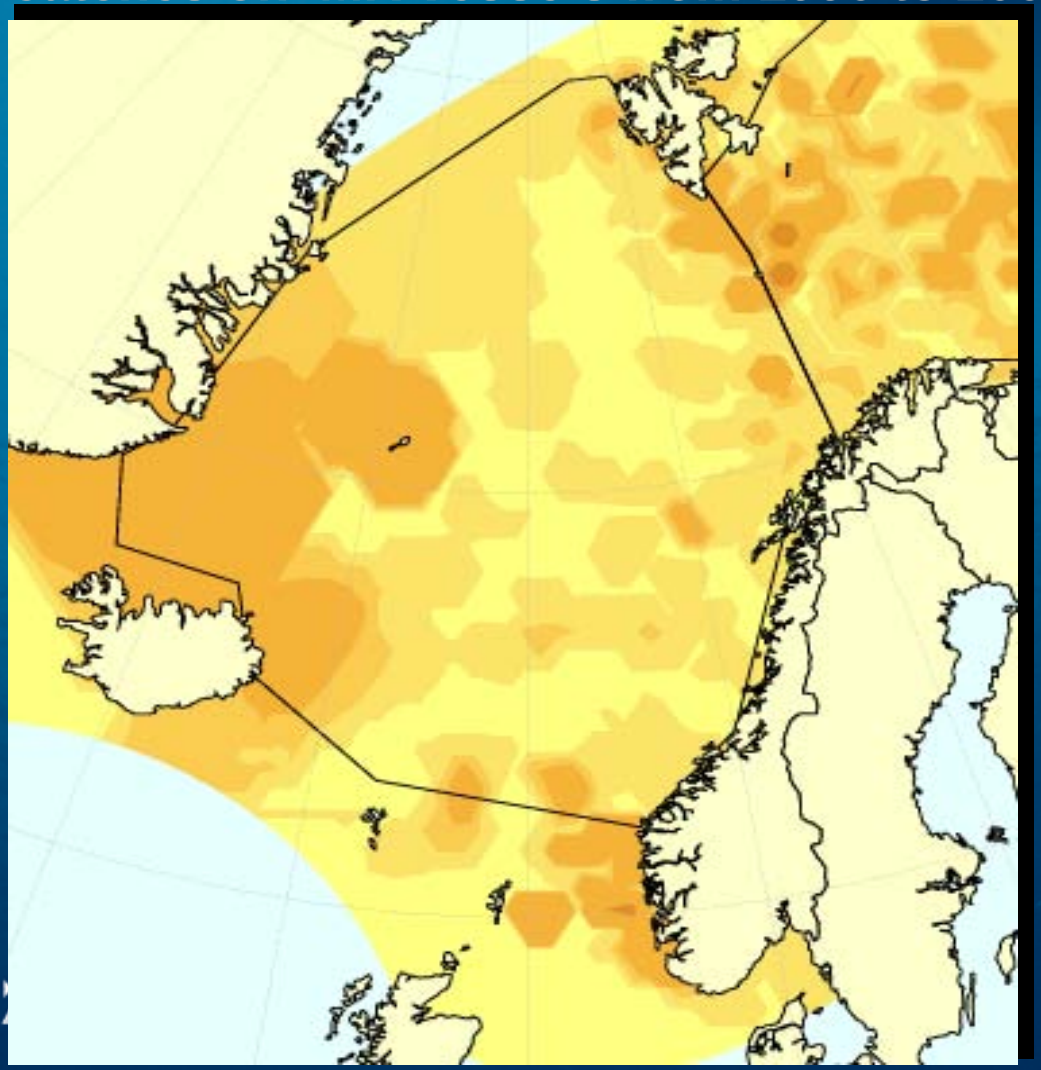


# Results

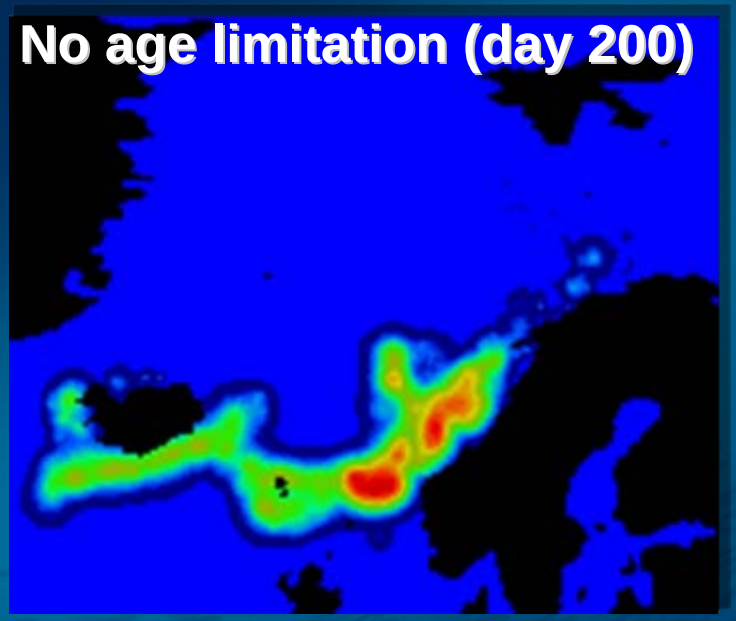
- Distribution: With age limitation

# Distribution

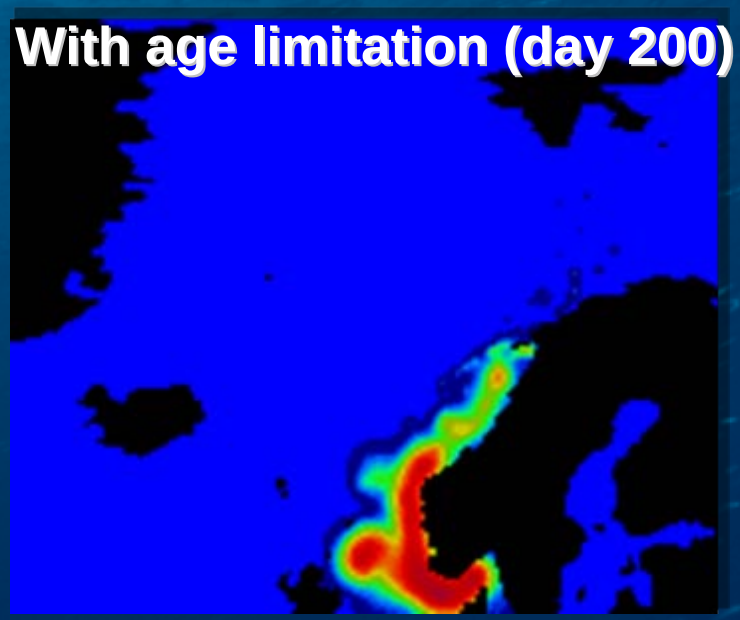
**Distribution of biomass of krill in trawl catches on IMR vessels from 1990 to 2004**



**No age limitation (day 200)**

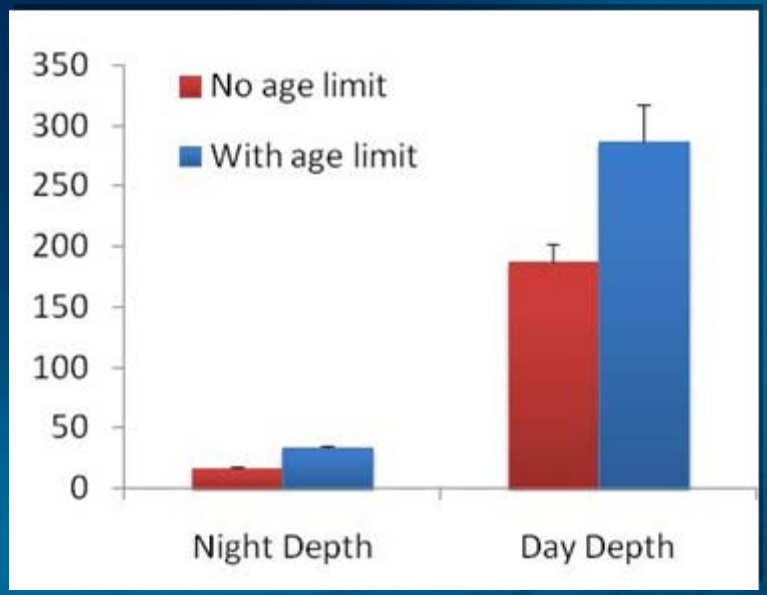


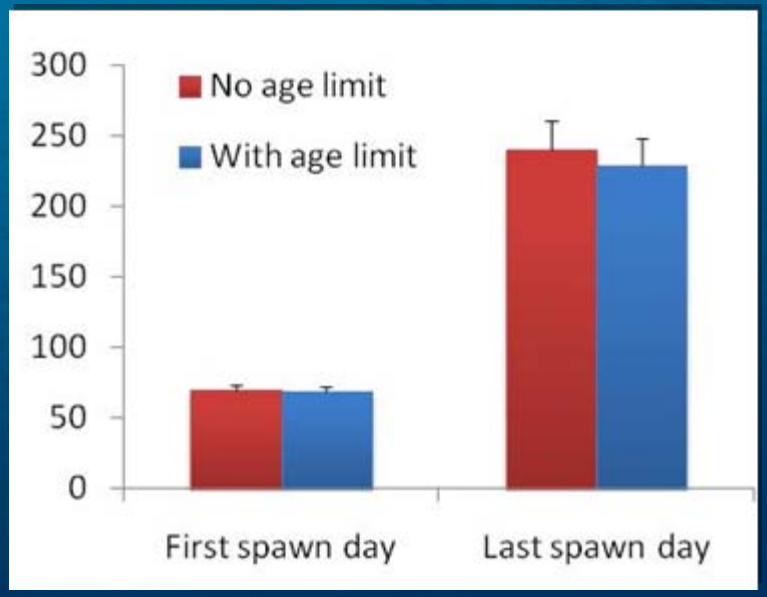
**With age limitation (day 200)**

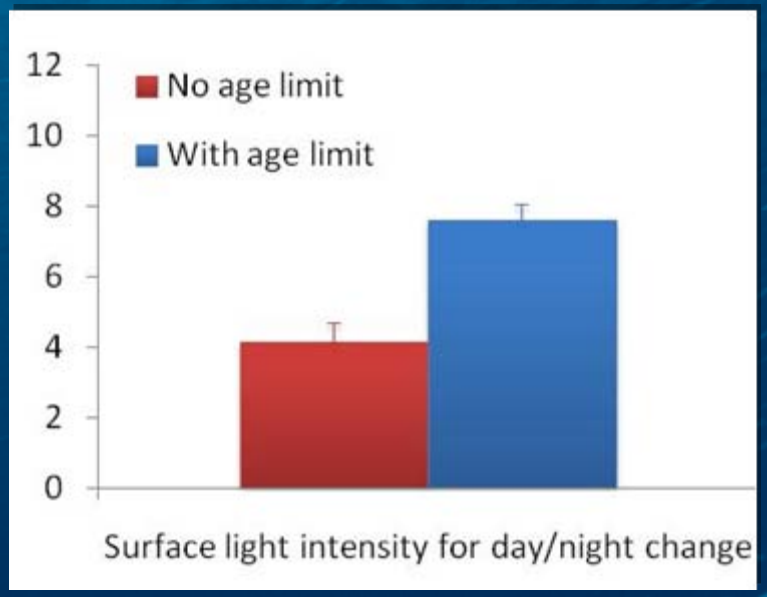


# Results

- Adaptation of strategy variables

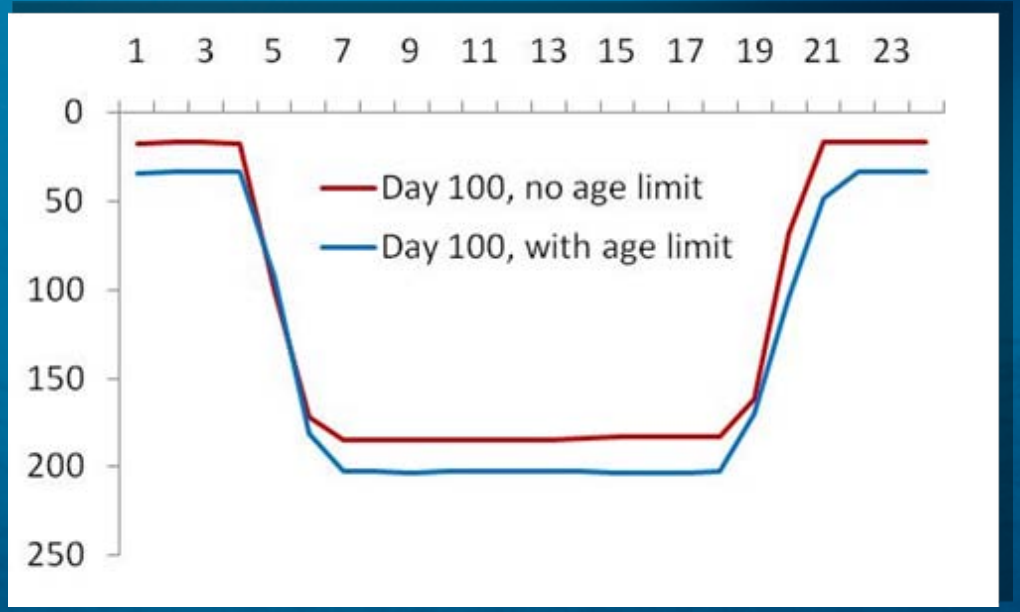


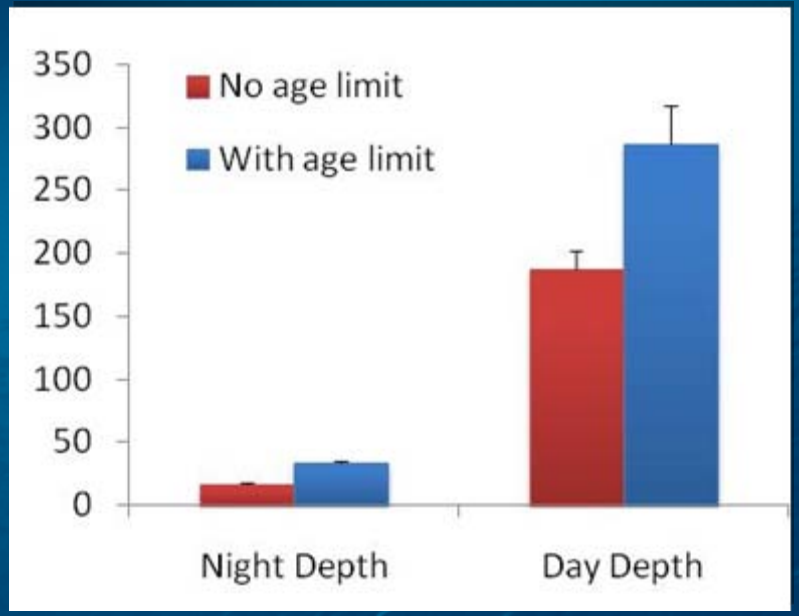



# Results

- Vertical migration



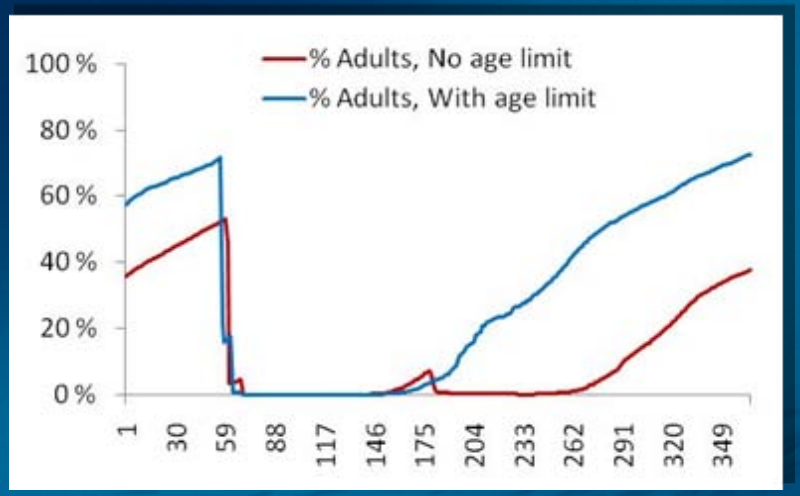



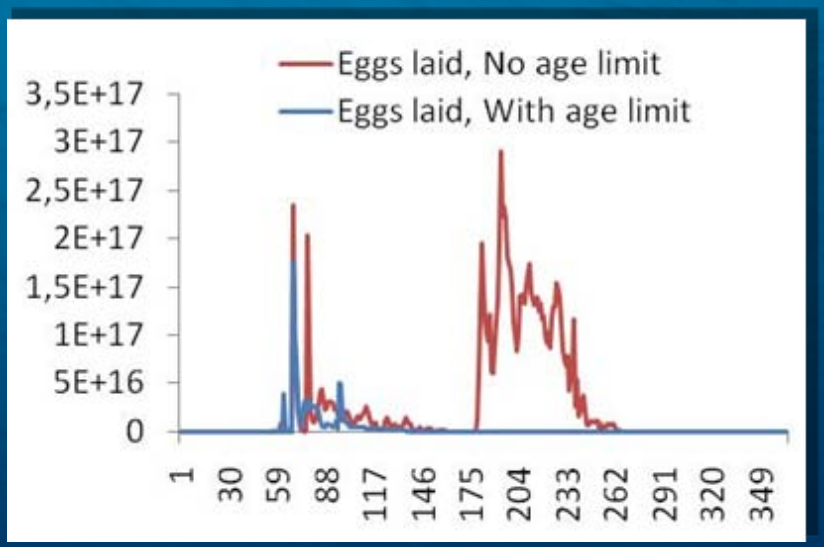

No age limit:
Yearly adult carbon uptake from phytoplankton: 35%

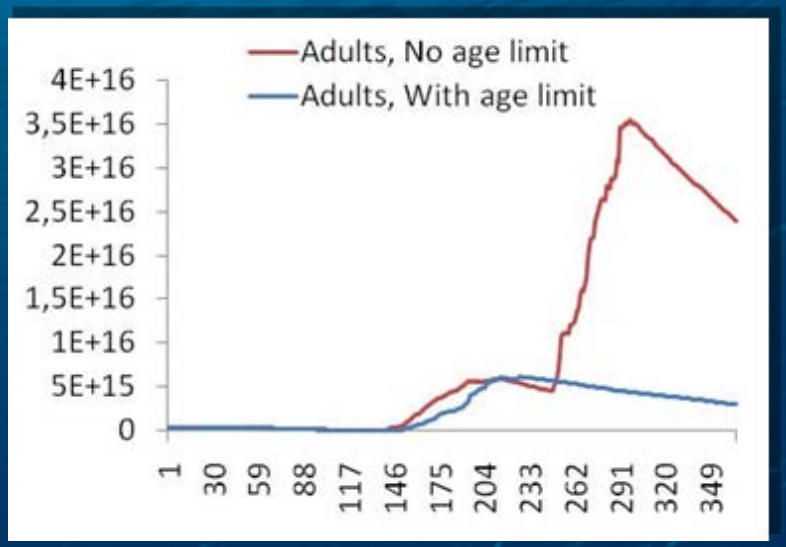
With age limit:
Yearly adult carbon uptake from phytoplankton: 21%

# Results

- Population dynamics



# Result summary

- We can apply evolutionary theory to estimate key life-history strategies of populations.
- Different sets of evolved life-history strategies have the potential to significantly alter population dynamics and geographical distribution.
- Individual-based population dynamic models are dependent on good parameterisation of important processes.

# The road ahead

- Currently the model lack real-time feedback on variables such as prey density and density dependent competition (both inter- and intra-specific)
- This makes it very hard to avoid uncontrolled population growth (knife-edge balance) and thus numerical values for biomass are unreliable.
- We are currently working on linking together several similar models in order to obtain the biological feedback needed.

# NORWECOM.E2E (end to end)

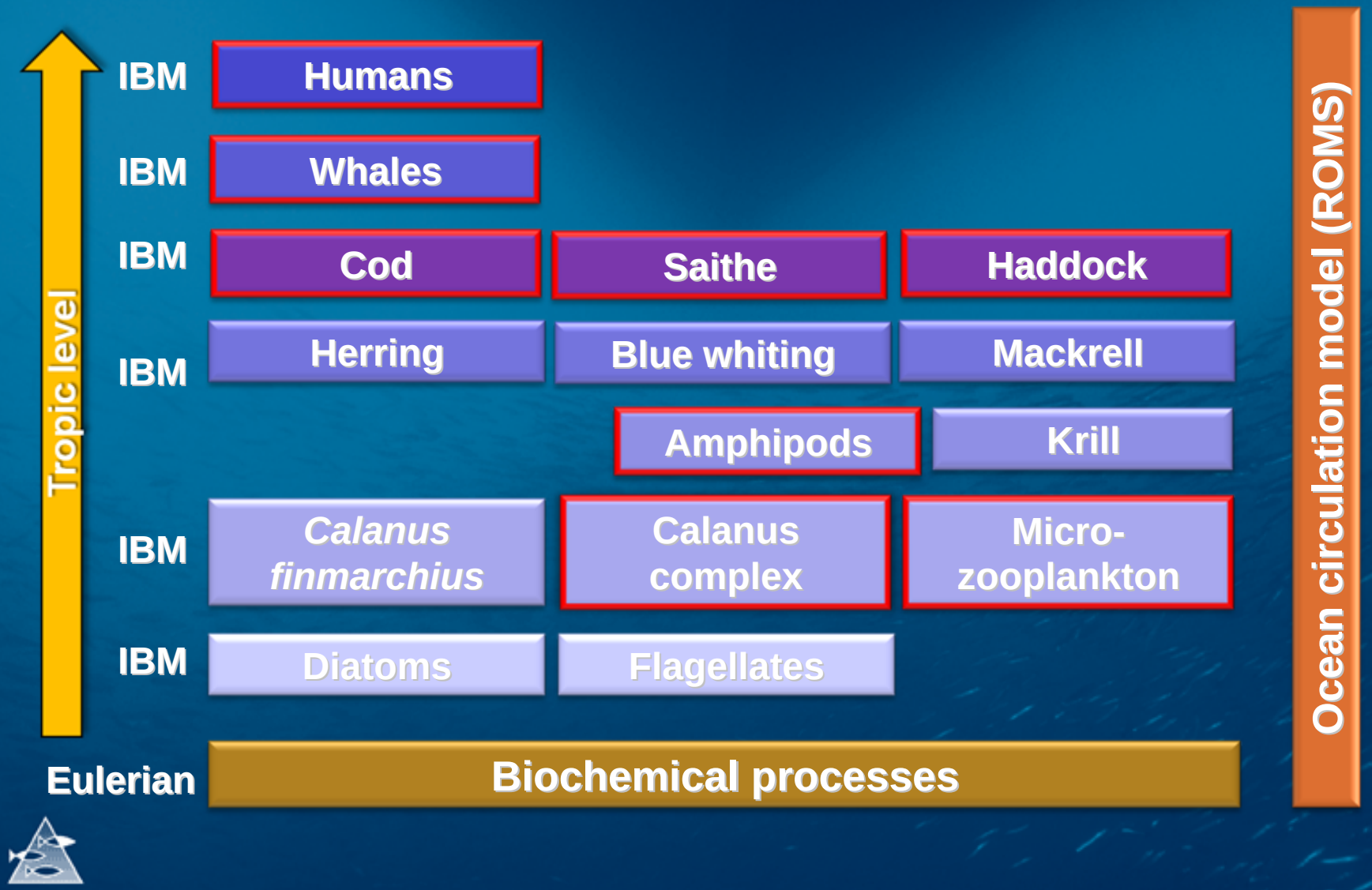



Foto: Cecilie Broms