Observation and risk assessment analysis of the invasive *Mnemiopsis leidyi* in the North Sea

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Science for the new regulation
2nd of April 2014
Ghent University

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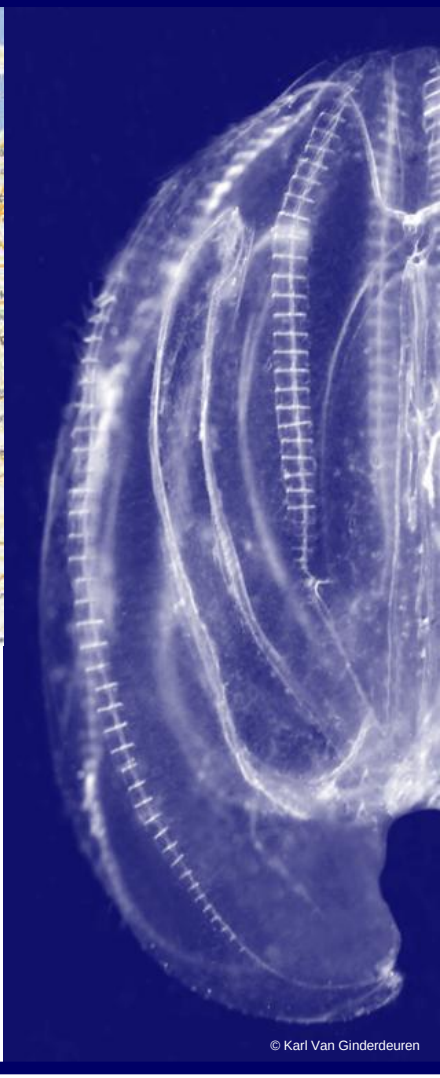
Interreg 2 Seas project MEMO

Spatio-temporal distribution

Biology, physiology and feeding

Ecological and socio-economic impact



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1. *Mnemiopsis leidyi* –succesfull invader
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5. Concerns


Fishing 'destabilises Black Sea'

Excessive fishing in the Black Sea has triggered major changes in the marine ecosystem, scientists suggest.

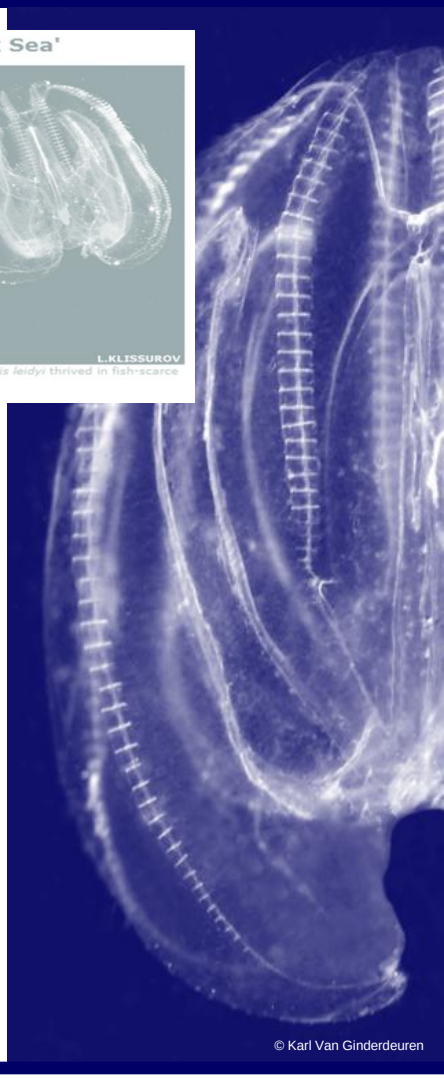
The collapse of fish stocks altered the sea's food chain, triggering a "regime shift" that allowed a species of invasive jellyfish to bloom, they said.

But curbing fishing will not be enough to return the habitat to a stable state unless pollution and biodiversity controls are also adopted, they warn.

The findings appear in the Proceedings of the National Academy of Sciences.

L.KLISSUROV

Mnemiopsis leidyi thrived in fish-scarce waters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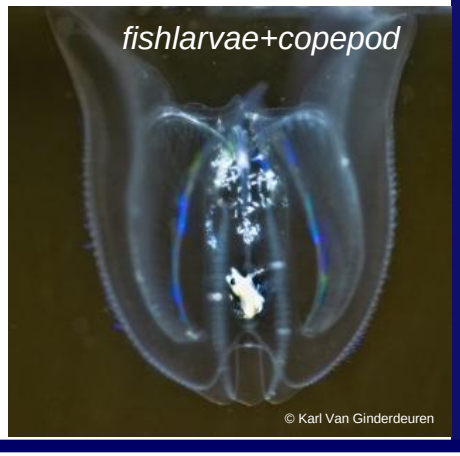
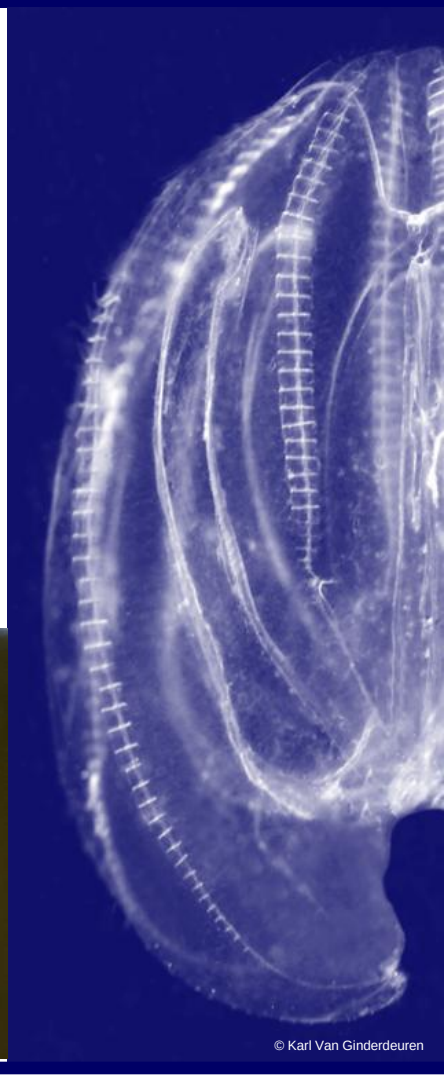
Mnemiopsis leidyi – invasive species

- Ctenophore native to Atlantic coast of North and South America
- High feeding rate on zooplankton
- High fecundity (self-fertilization) and fast growth rate
- Tolerance to a wide range of environmental parameters

  Eurytherm: 0-32°C
  Euryhaline: 2-38 PSU
  Oxygen: 1.0 mg DO/L
  (Kremer 1994, Purcell 2005)





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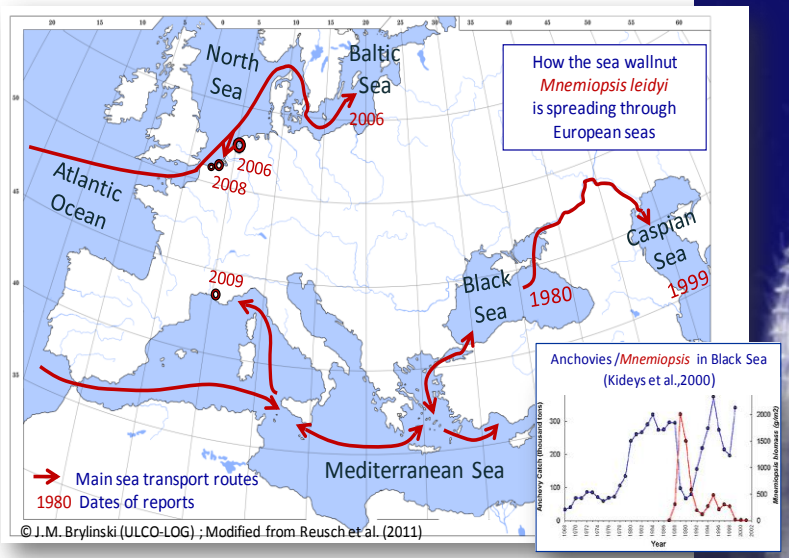
Worrying history

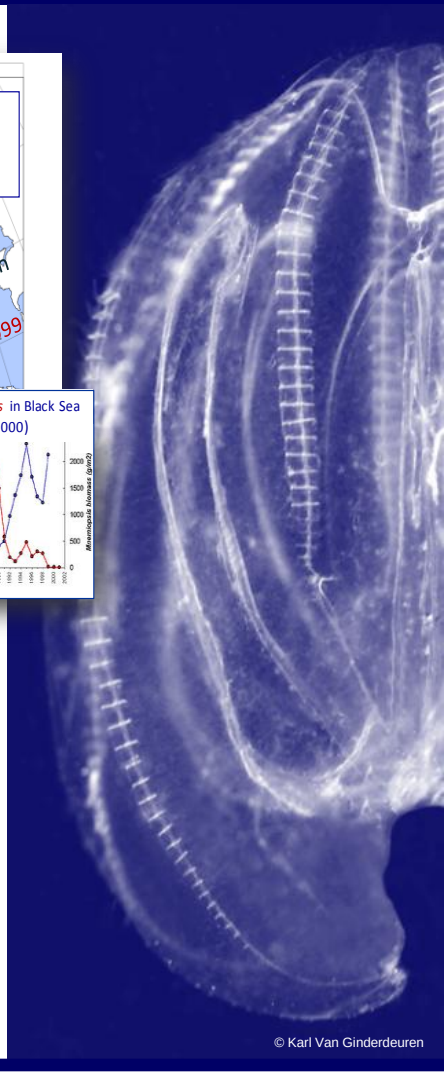
80-90s:

- Caspian and Black Sea
- Destroying ecosystem
- Crash in planktivorous fish
- Economic losses



Mnemiopsis is spreading through European seas:

- 2009: Mediterranean Sea (Berre lagoon)
- 2006: Baltic Sea + Dutch coasts
- 2007-2010:
  North of France, Belgian ports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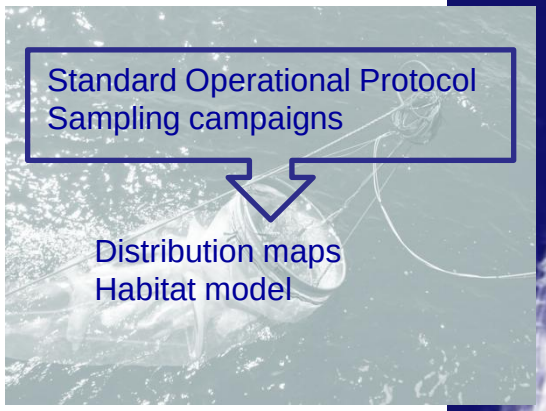

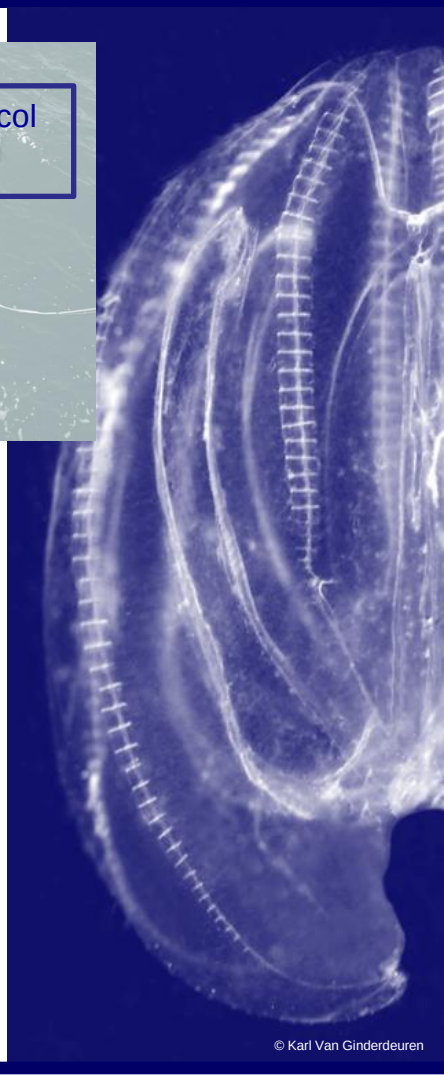

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Spatio-temporal distribution & Habitat model

Low densities in BPNS
-> North sea, autumn: max. 0,15 ind./m3

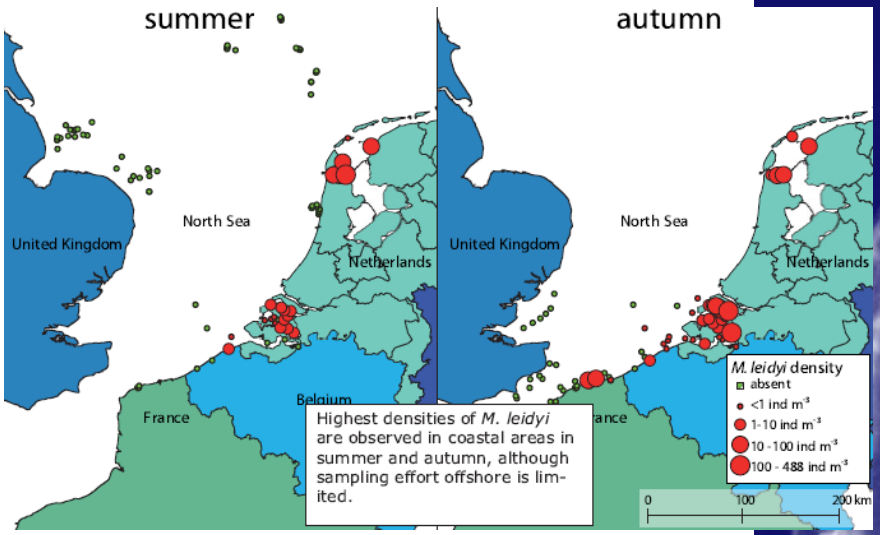
High densities in estuaries
-> Wadden Sea: 490 ind.m-3 (van Walraven *et al*. 2013)

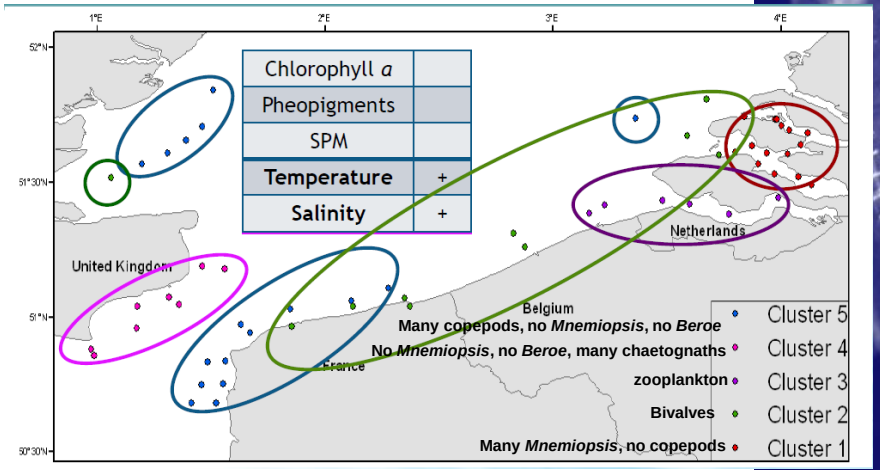
➡ Presence in summer and autumn
➡ Semi- enclosed basins

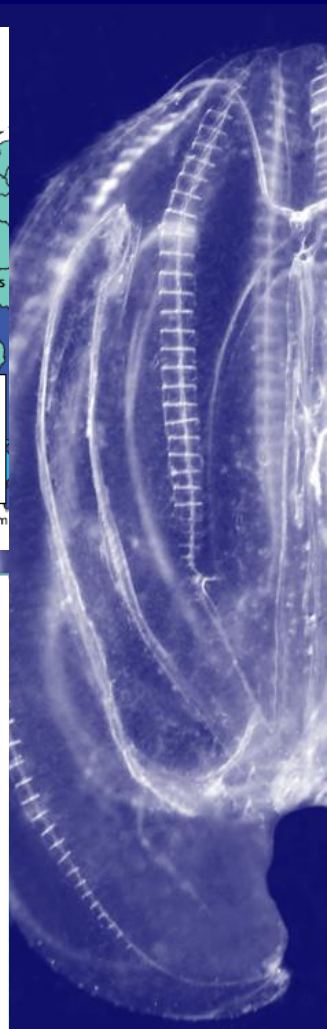
5 ecoregions of environmental parameters

➡ *Mnemiopsis* and zooplankton presence
➡ Competition/predation
Mnemiopsis, copepods and chaetognaths

(Vansteenbrugge *et al.*, in prep; Antajan *et al*., in prep)







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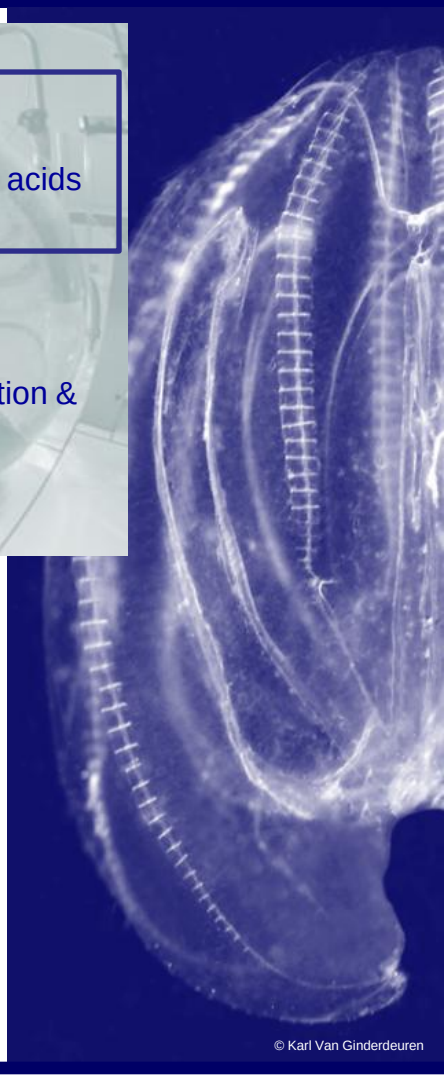
Culturing experiments
Feeding experiments
Stable isotope and fatty acids
Stomach analysis

Conditions for reproduction & growth
Diet composition
Trophic position



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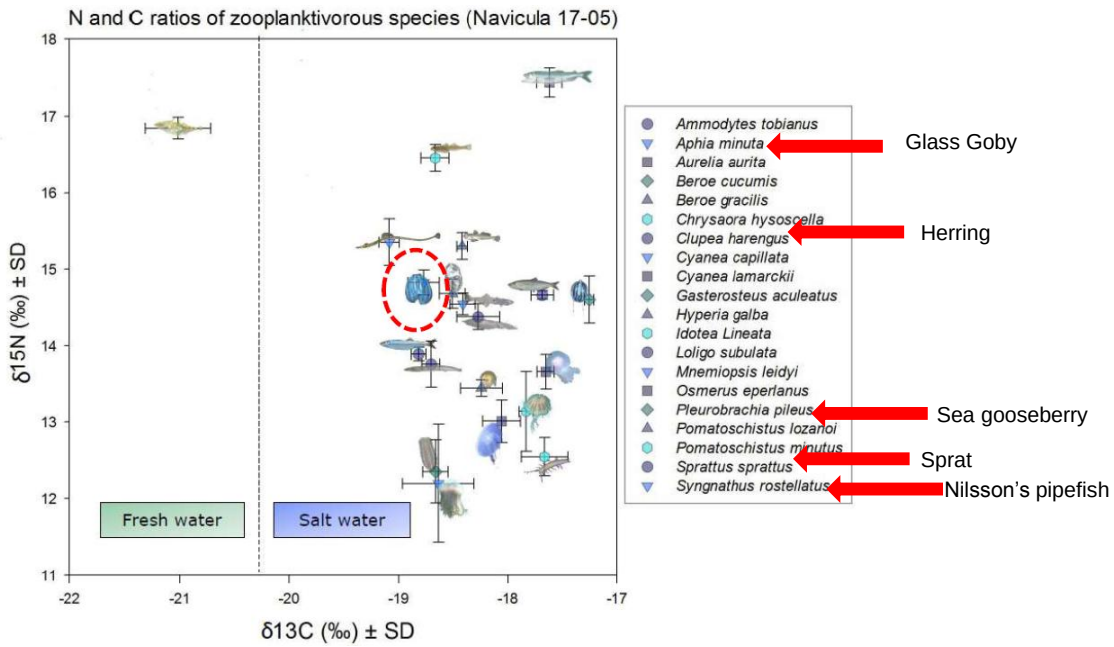
Trophic role and position in the food web

Competition



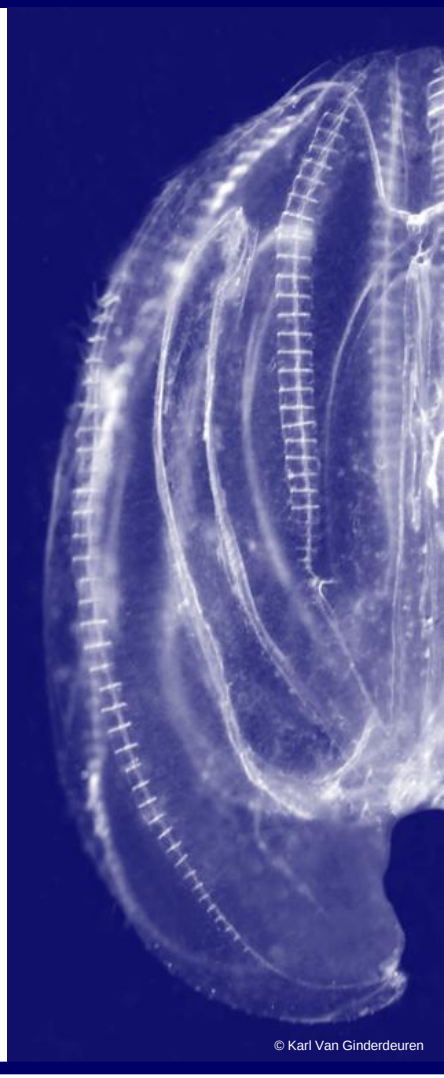
Opportunistic predator

-> Consumes zooplankton like larvae of commercially important fish species
-> No lipid reserves, invests in rapid growth and reproduction

Who eats *M. leidyi?*

-> Found in stomachs of herring, sprat, sandeel

(Vansteenbrugge *et al.*, in prep; van Walraven *et al.*, in prep)



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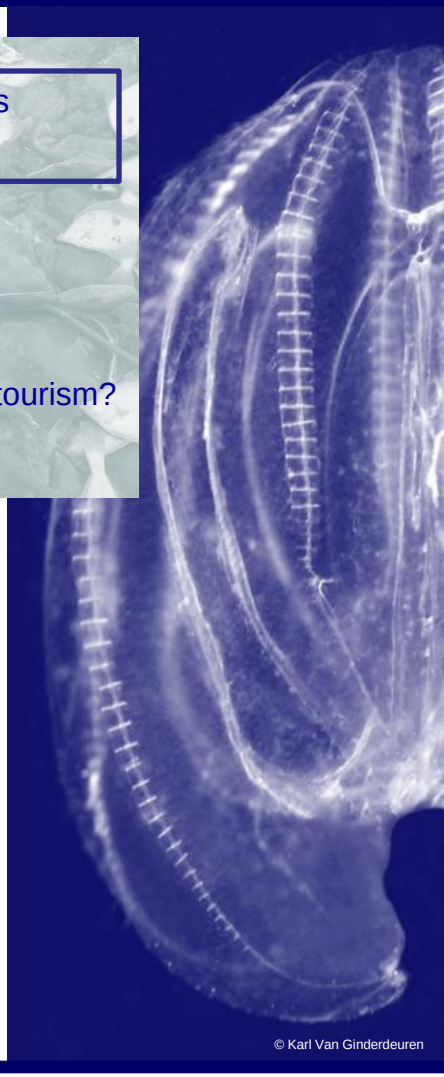
Socio-economic surveys
Modelling work

Wintersurvival
Risk analysis of blooms
Role of estuaries
Impact on fisheries and tourism?



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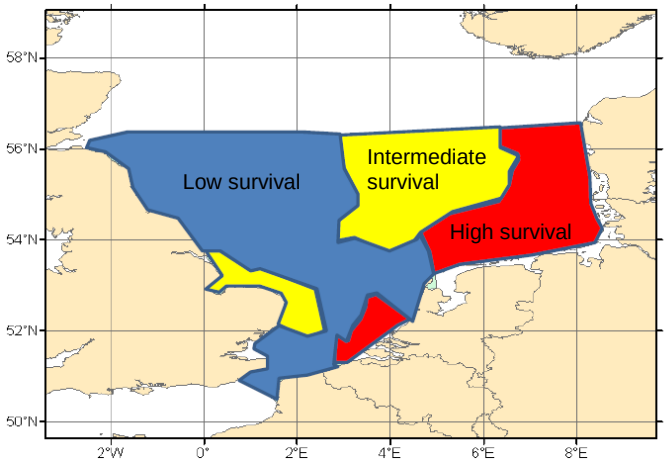
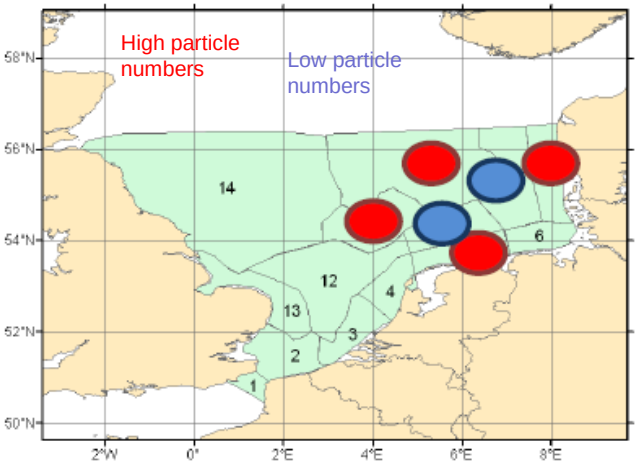
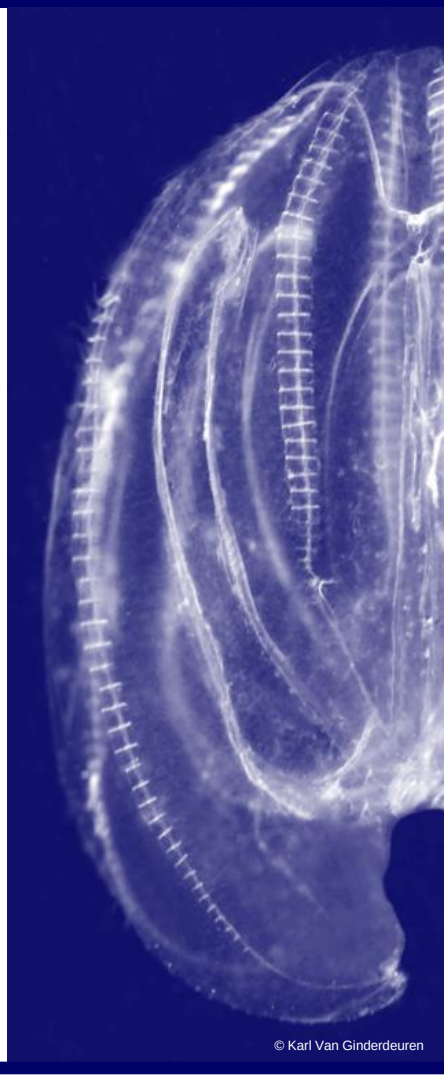
Are they able to survive winter?



Where will they survive? Habitat model.



Where do they come from? Particle tracking model.



- Coastal areas in the south-eastern North Sea high retention /concentration rates
- East Anglia coast appears a potential area of invasion for *M.leidyi*

(David *et al.*, in prep.)

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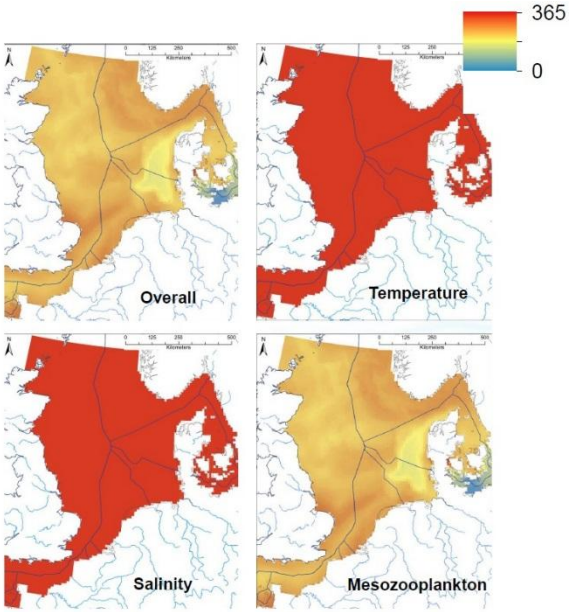
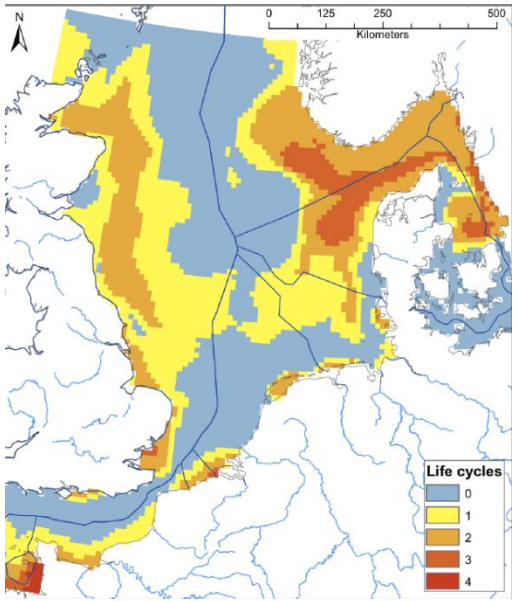
Are blooms possible in the North Sea?



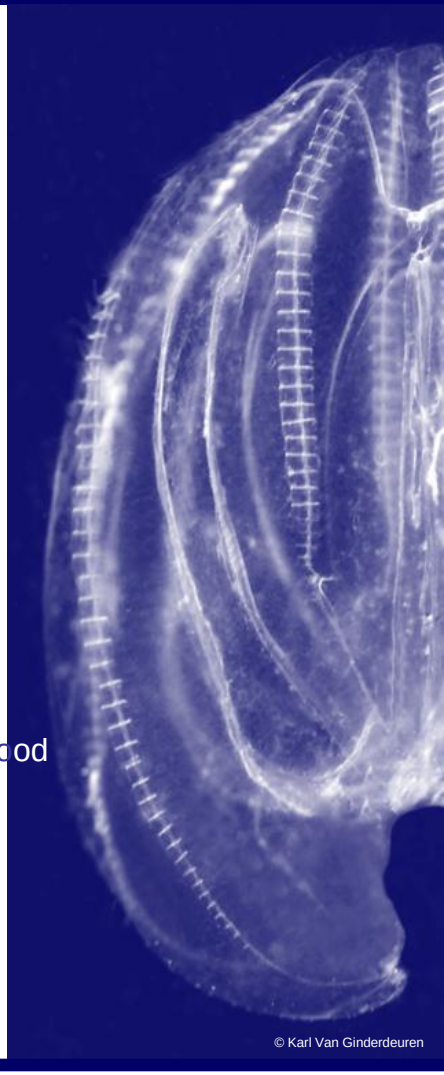


3D hydrodynamic model (GETM) coupled with an ecosystem model (ERSEM).

- Survival determined by food availability
  - Max. 336 days suited
  - Winter conditions not ideal
- Reproduction determined by temperature and food
  - Up to 178 days suited (summer)
  - Up to 4 life cycles

→ Blooms not very likely in North sea, more likely in estuaria

(Collingridge, K. *et al*. in press.)



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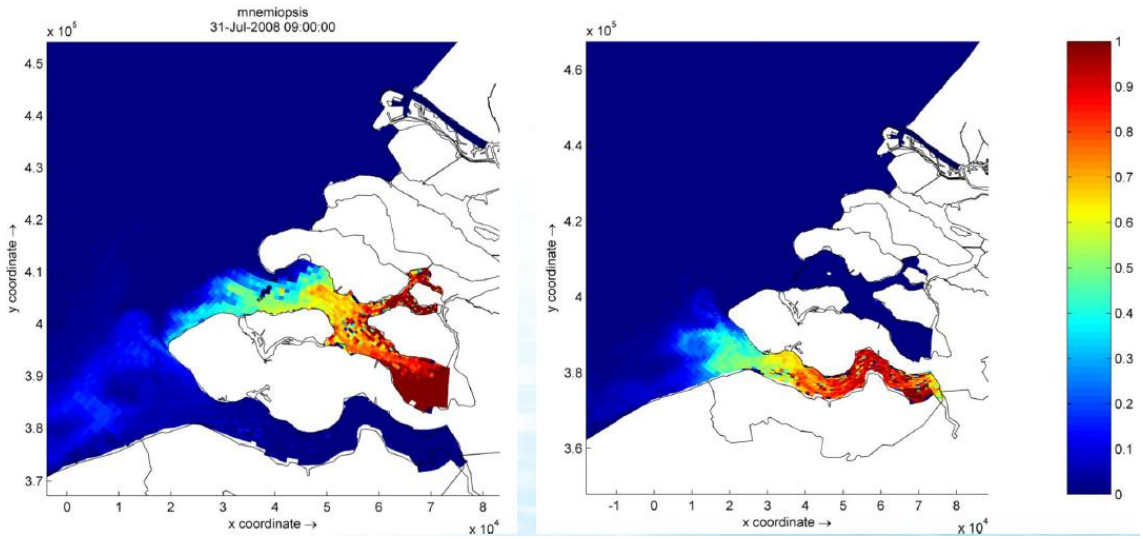
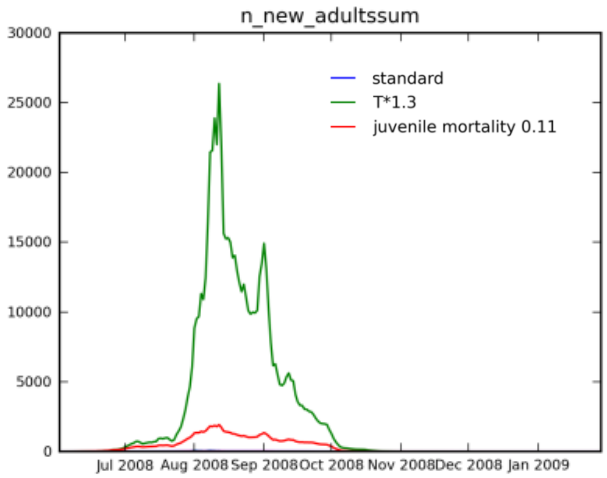
Are estuaries a source of *Mnemiopsis*?





- Year-round presence of *Mnemiopsis leidyi* in estuaries
- Estuarine /coastal exchange
- Climate warming can cause increase of *Mnemiopsis* in the North Sea

(van der Molen *et al*., in prep.)

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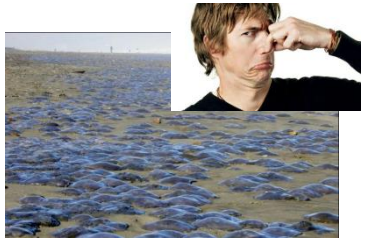
Socio-economic impact

"Potential economic impacts of jellyfish invasions along the English coast, with a special focus on *Mnemiopsis leidyi*."

UK: No *Mnemiopsis* present
Assumptions on possible scenarios of an invasion of jellyfish on the English coast



➡ **When large densities would cause odour nuisance jellyfish, there would be a substantial impact on tourism.**
(Schaafsma *et al.*, in prep.)

"Jellyfish, jellypress and jellyperception"

Mnemiopsis leidyi has limited size and is fragile-> direct impact of blooms would be relatively small
Analysis of Flemish fishermen and tourists' perceptions about jellyfish
Personal experience!

(Vandendriessche *et al*., in prep.)

	Divers	Tourism	Fishermen	Power plants
Knowledge	Species	No general knowledge		No respons
Observations	Increase	No attention	No ML found	
Perception	Caution	Negative aspects Risk of stings	+ mesh size (escape) - fuel cost (clogging nets)	

➡ **First management tool: information to all parties involved -> monitoring alert system**
Future blooms are likely to increase -> mitigation

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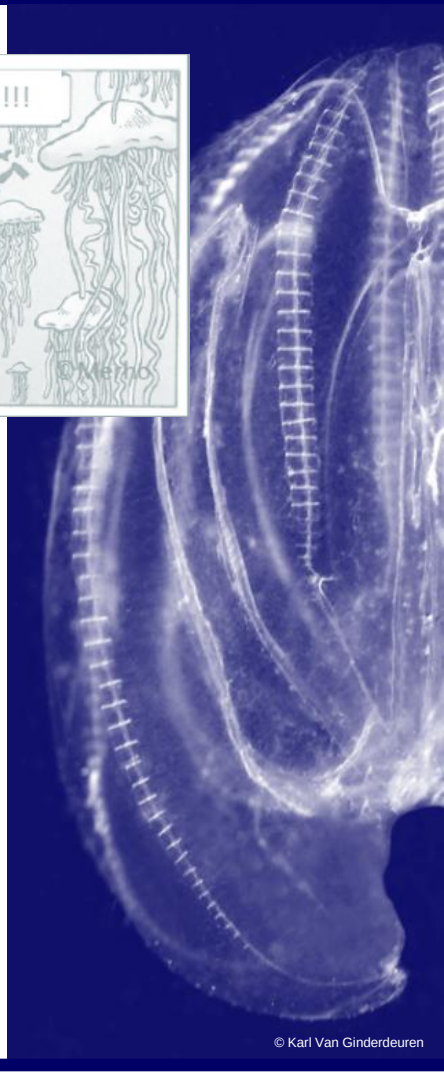
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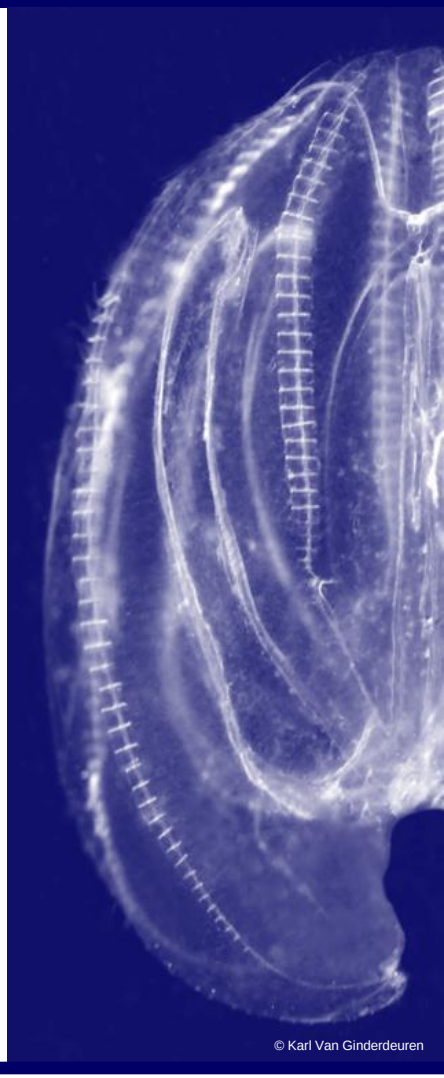
Concerns

- Presence in our coastal areas
- Zooplanktivorous consumer
- Importance of confined harbours and basins
- Caution for:
  - Increase of the seawater temperature
  - Exchange of ships' ballast water
  - Rising pressure on the marine ecosystem
- Possible major consequences for fisheries, tourism and other commercial activities



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Thank you for your attention!

The MEMO-consortium

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