The invasive ctenophore *Mnemiopsis leidyi* in northern European waters and its potential impact on fisheries

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S7: Jellyfish in marine ecosystems and their interactions with fish and fisheries
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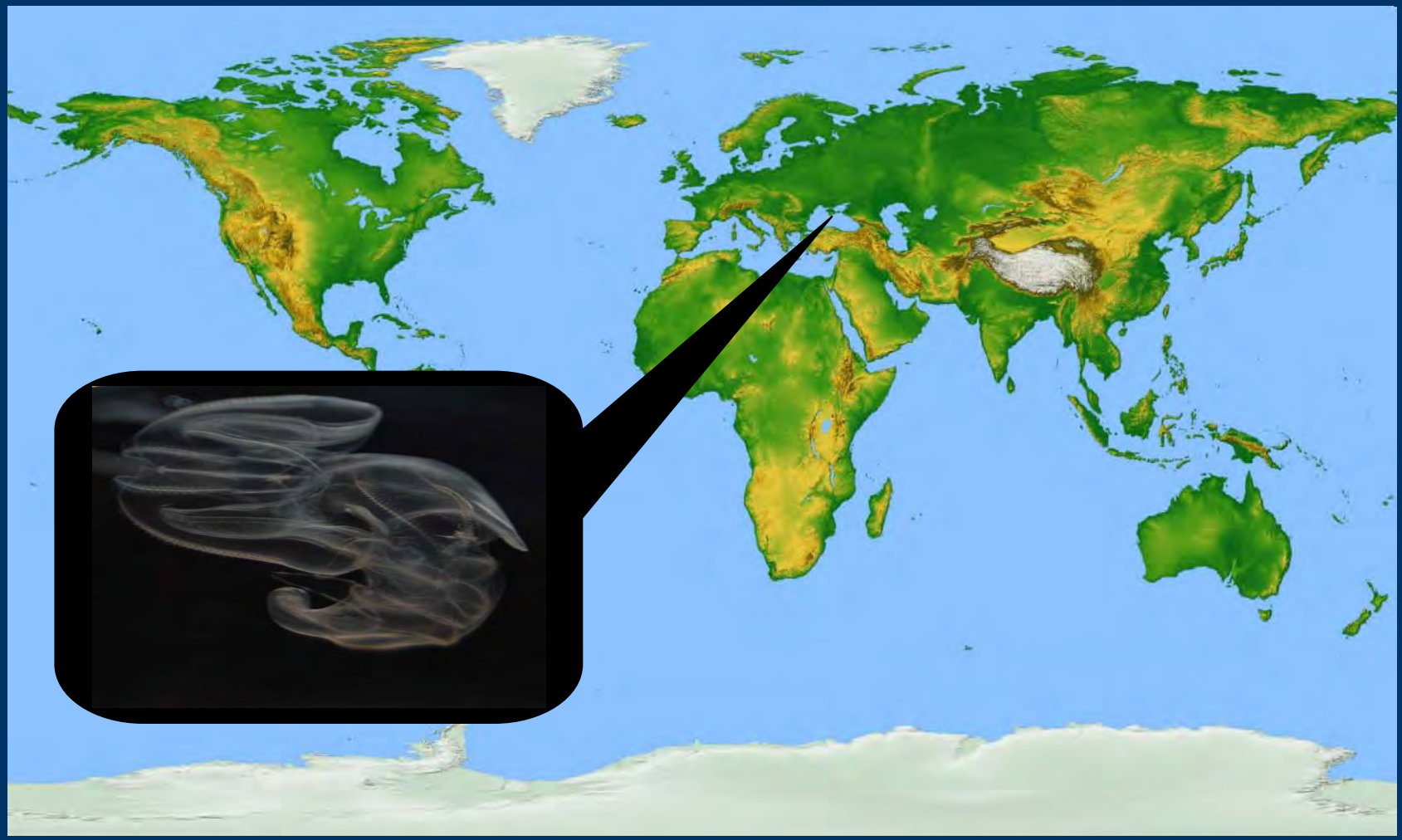
Mnemiopsis leidyi

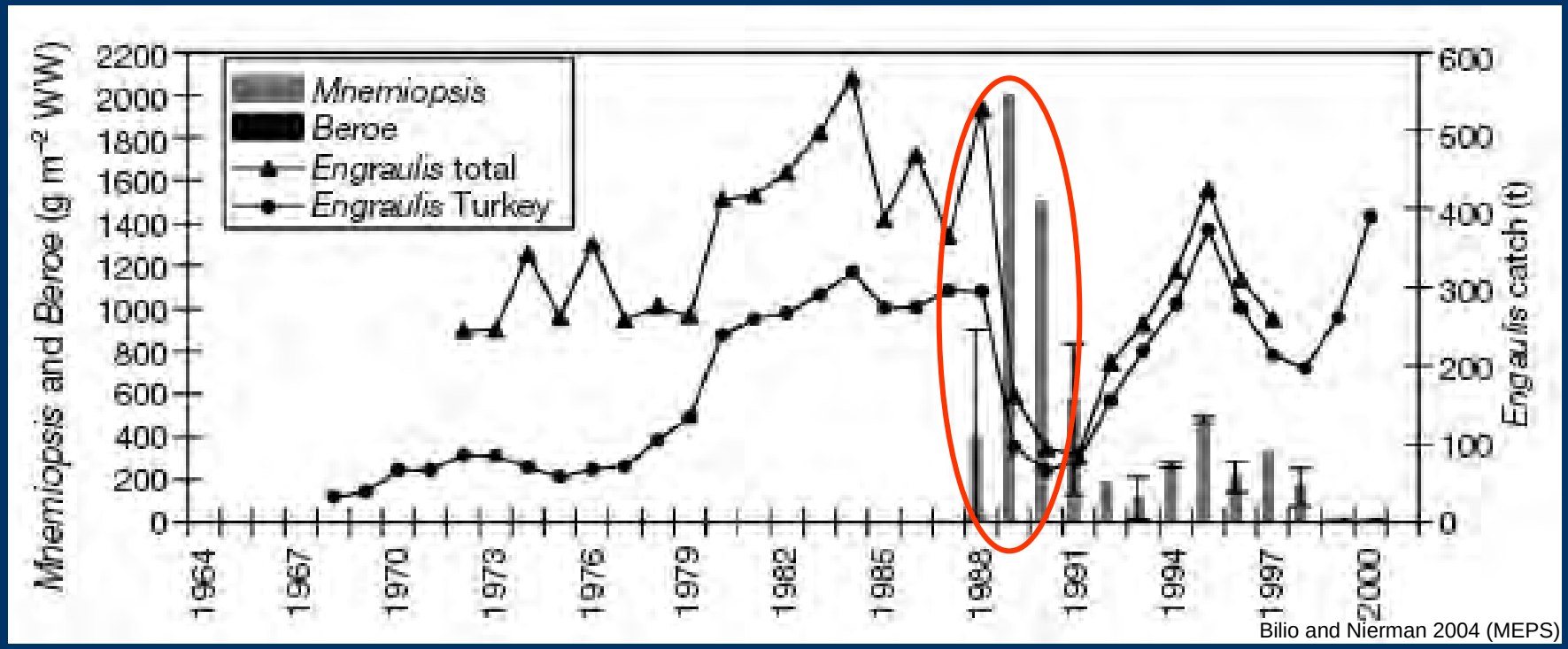
- Ctenophore (comb jelly)
- Native: East coast of America
- High feeding rates

Invasive comb jelly *Mnemiopsis leidyi*



Mnemiopsis leidyi in the Black Sea

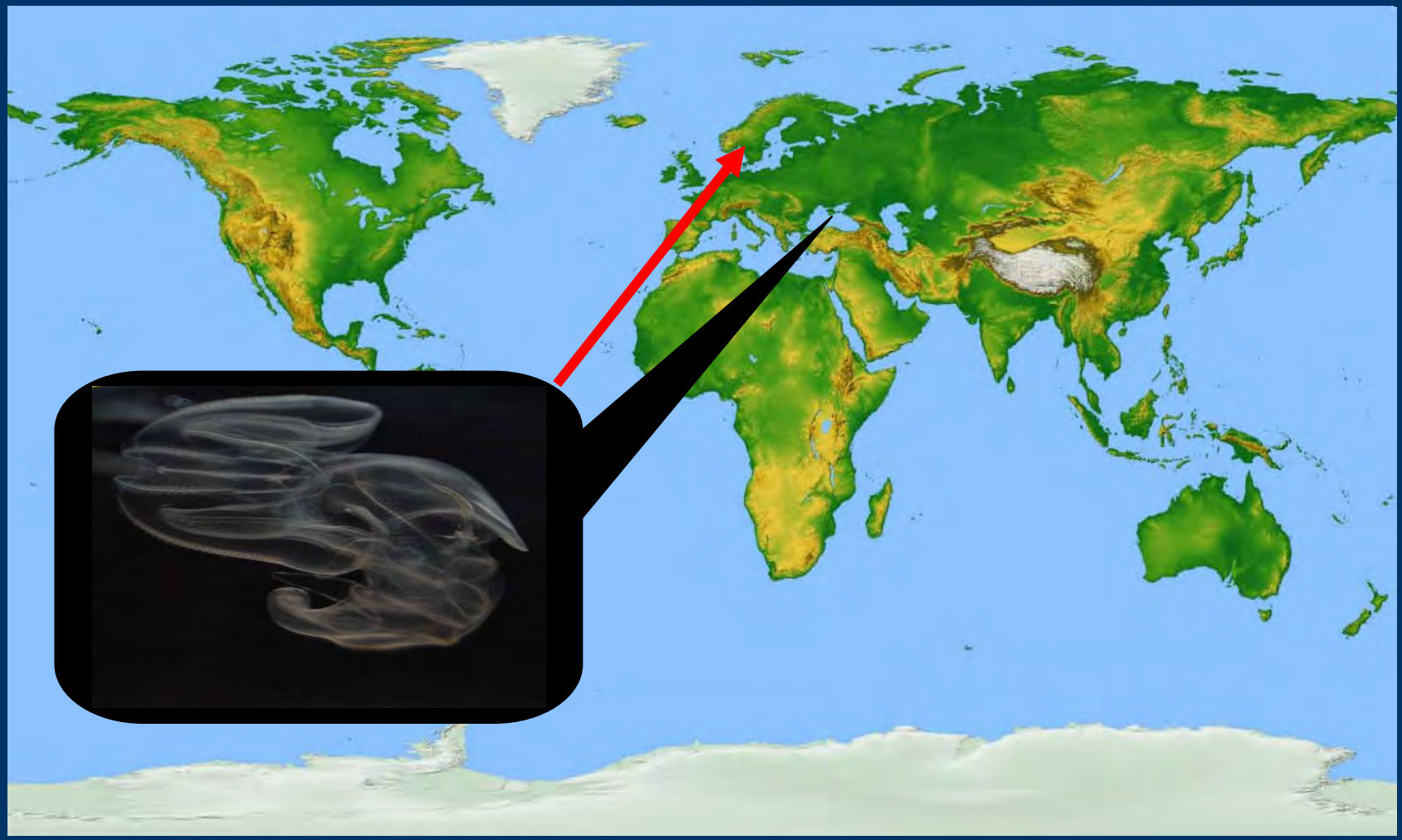
Fish and *M. leidyi* in the Black Sea



Bilio and Nierman 2004 (MEPS)

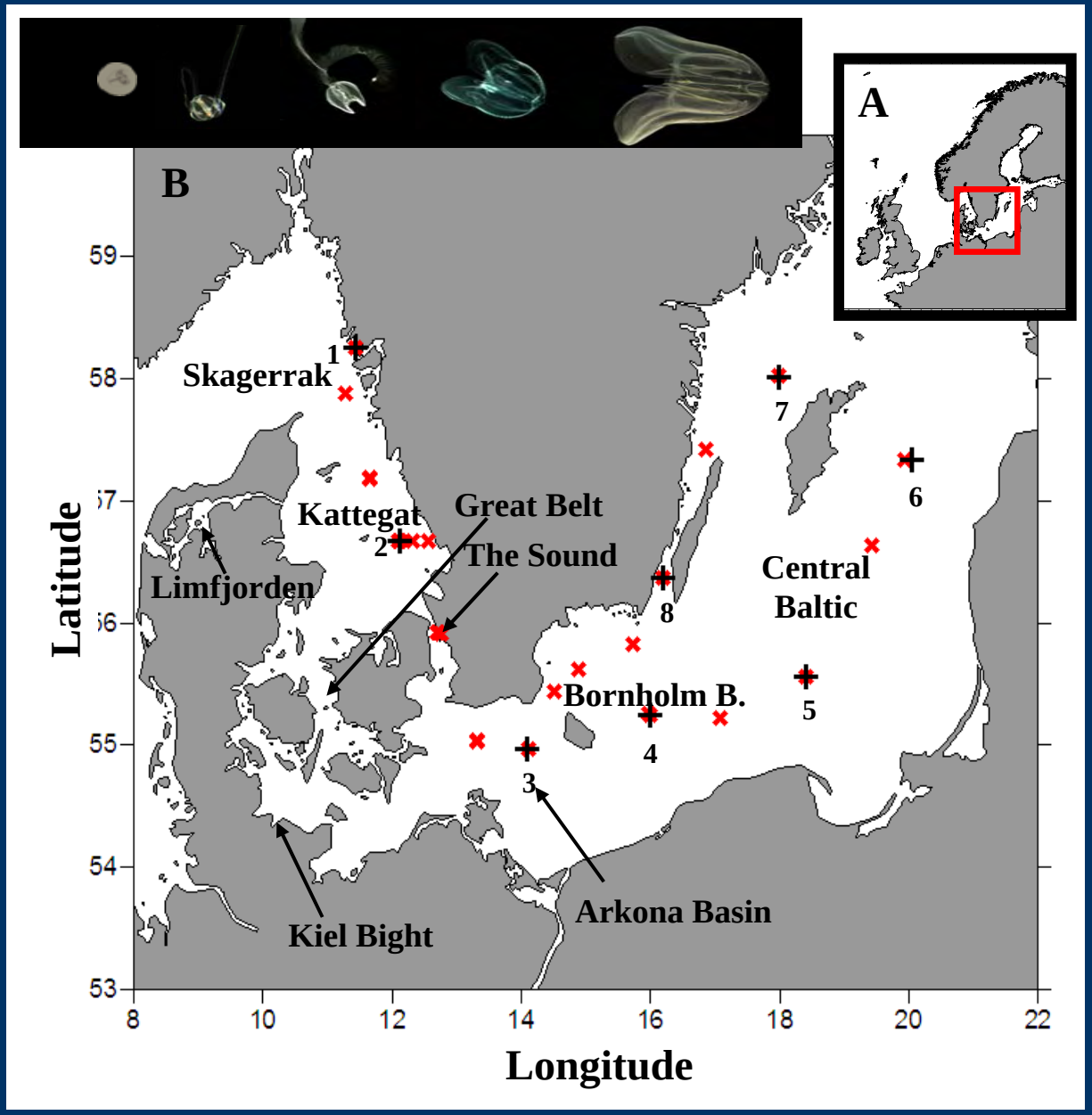
Over-exploitation of pelagic fish species e.g. anchovy
Severe eutrophication
Complex interactions

M. leidyi sighted in N. Europe in 2005



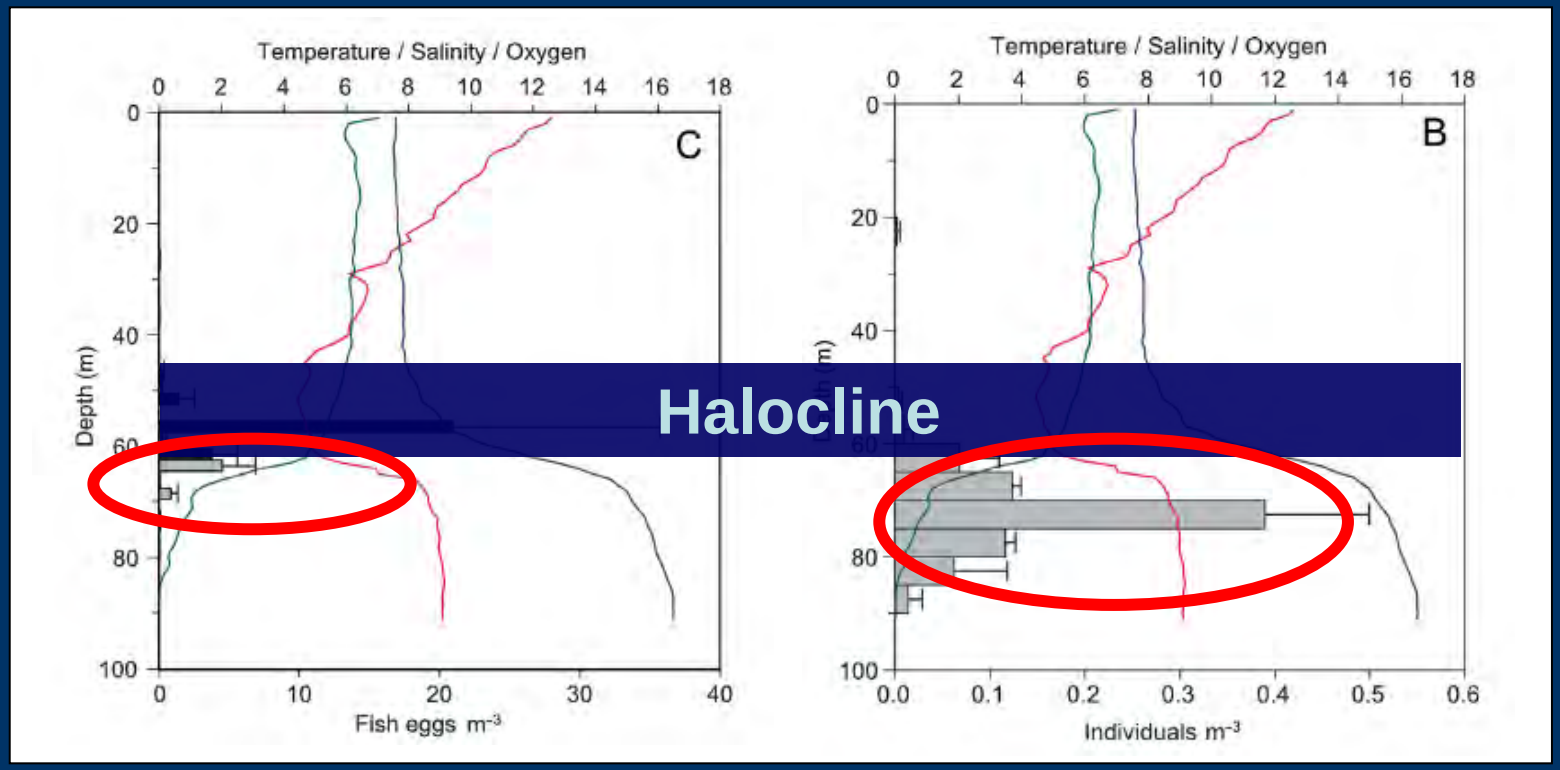
Mnemiopsis leidyi in Northern Europe

Baltic Sea


A
B
Skagerrak
1
Kattegat
2
Great Belt
The Sound
Limfjorden
Central
Baltic
6
7
8
Bornholm B.
4
5
3
Kiel Bight
Arkona Basin
Latitude
Longitude
59
58
57
56
55
54
53
8
10
12
14
16
18
20
22

Bornholm Basin / central Baltic

Spatial and temporal overlap with fish eggs



Cod eggs

Mnemiopsis leidyi

Temperature (°C, red line)
Salinity (psu, blue line)
Oxygen (ml l^{-1}, green line)

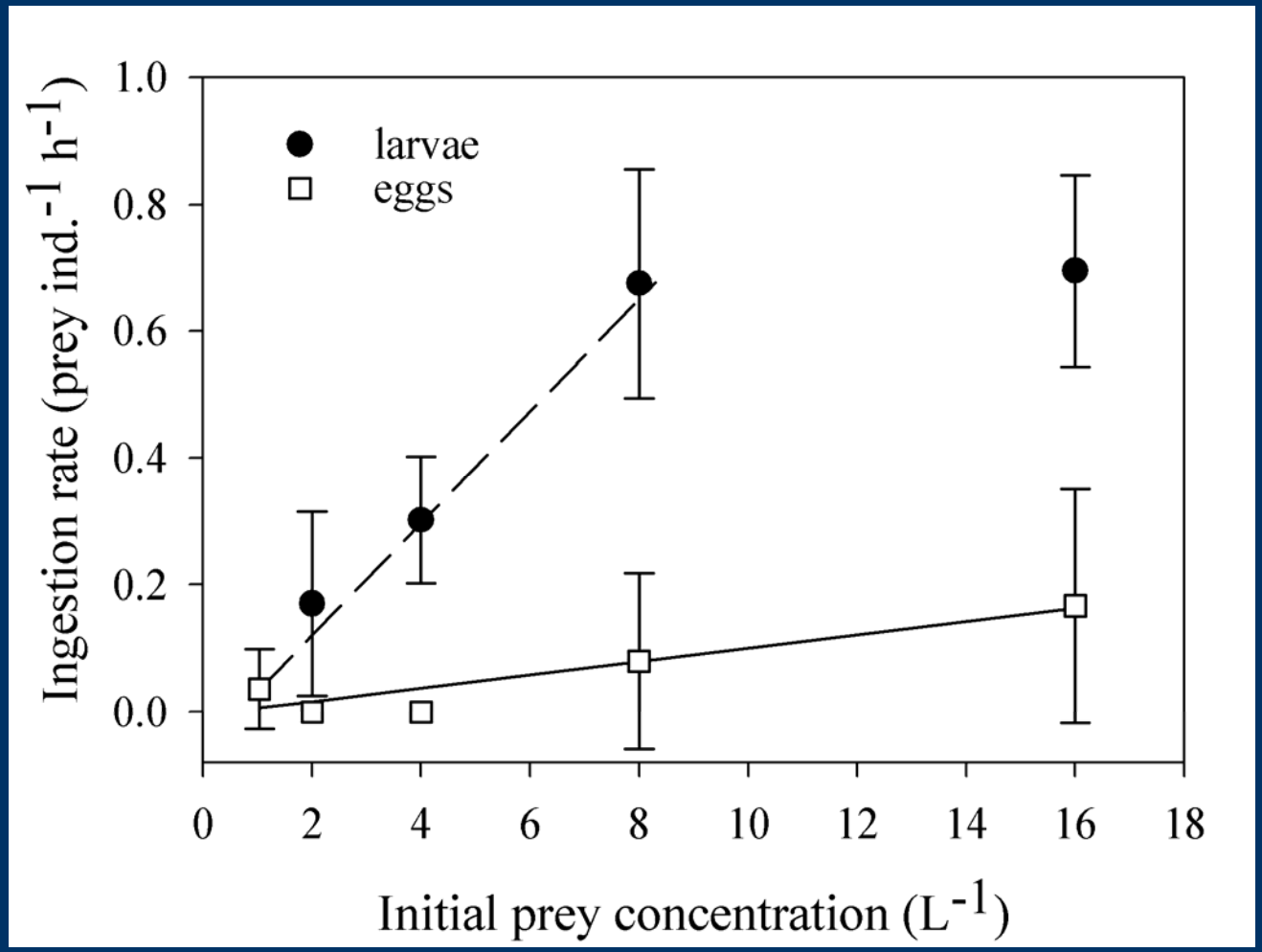
Haslob et al. 2007 (MEPS)

Objective I

Understand feeding interactions between *M. leidyi* and Baltic cod eggs & larvae

Due to high temporal and spatial overlap a large negative impact of *M. leidyi* on cod is feared.

Functional response cod egg & larvae

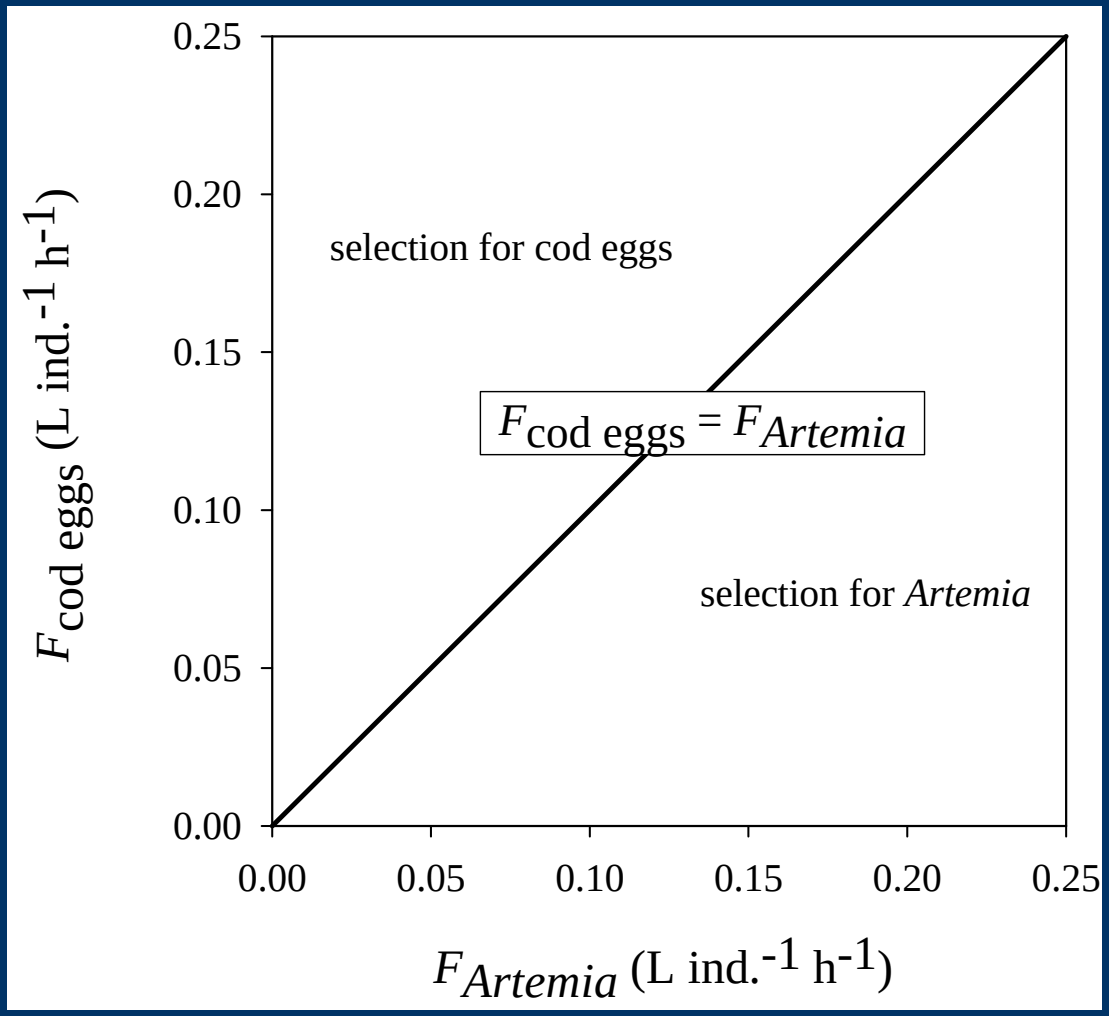


Ingestion rate increases up to 8 cod larvae L^{-1};
slope for cod eggs is not sign. different from zero

Jaspers et al. 2011 (L&O)

Food selection

Cod egg vs. *Artemia salina*



Jaspers et al. 2011 (L&O)

Food selection

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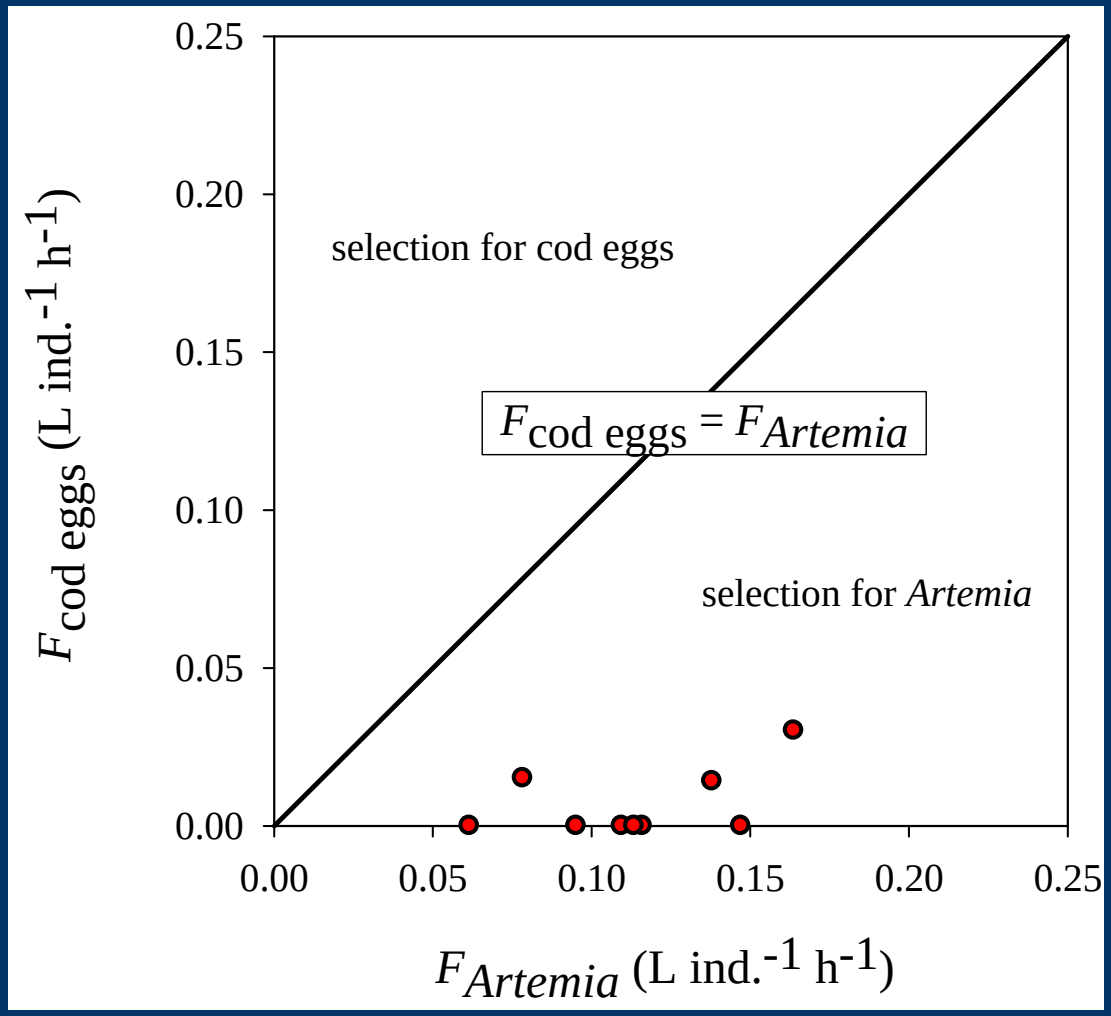
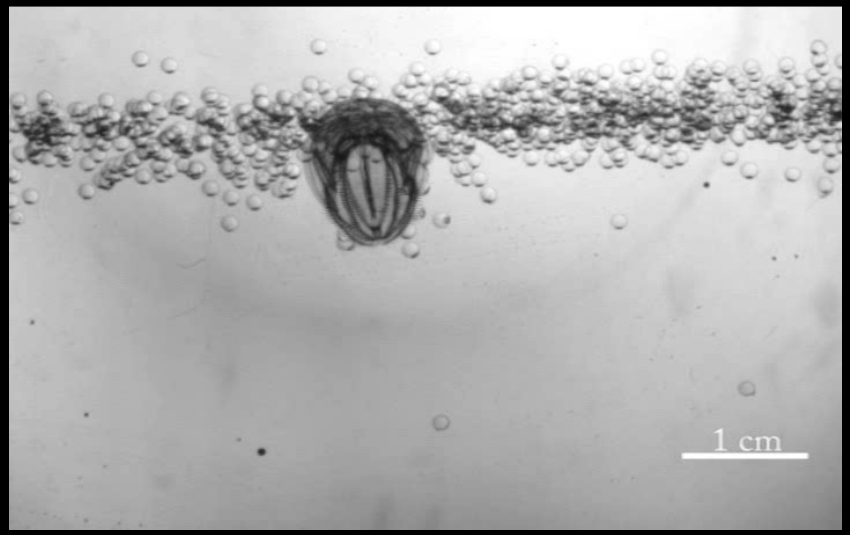


Jaspers et al. 2011 (L&O)

3D video observations

Mnemiopsis (not) feeding on cod eggs



Mnemiopsis feeding on cod larvae

"Normal" capture response
with lobe closure

Mnemiopsis 35mm oral aboral length

Direct effect: Results

Baltic cod
(*Gadus morhua callaris*)


Day 1


Day 2


Day 3


Day 4


Day 5


Day 6


Day 7


Day 8


Day 11


Day 2 post hatching

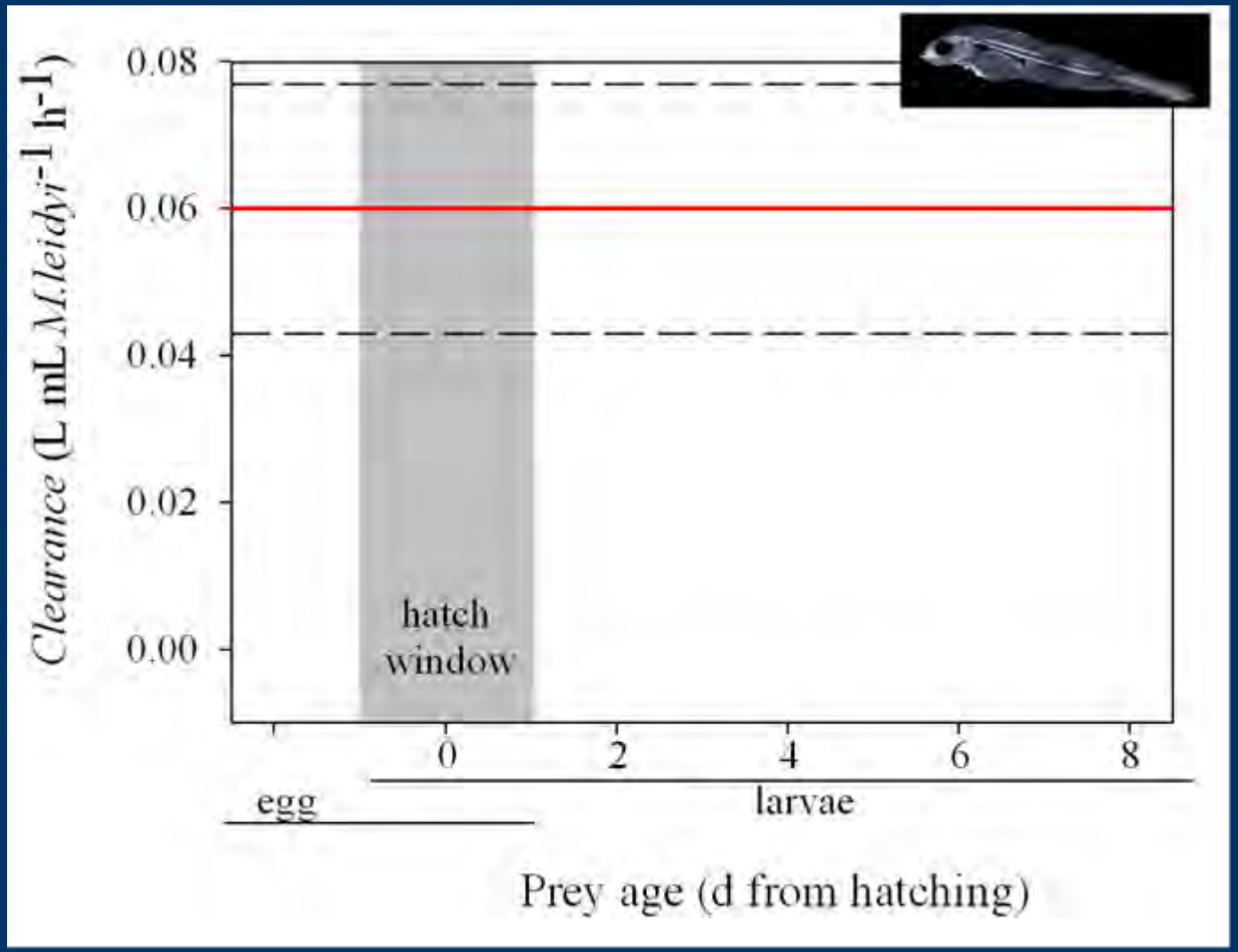

Day 4 post hatching


Day 6 post hatching


Day 9 post hatching

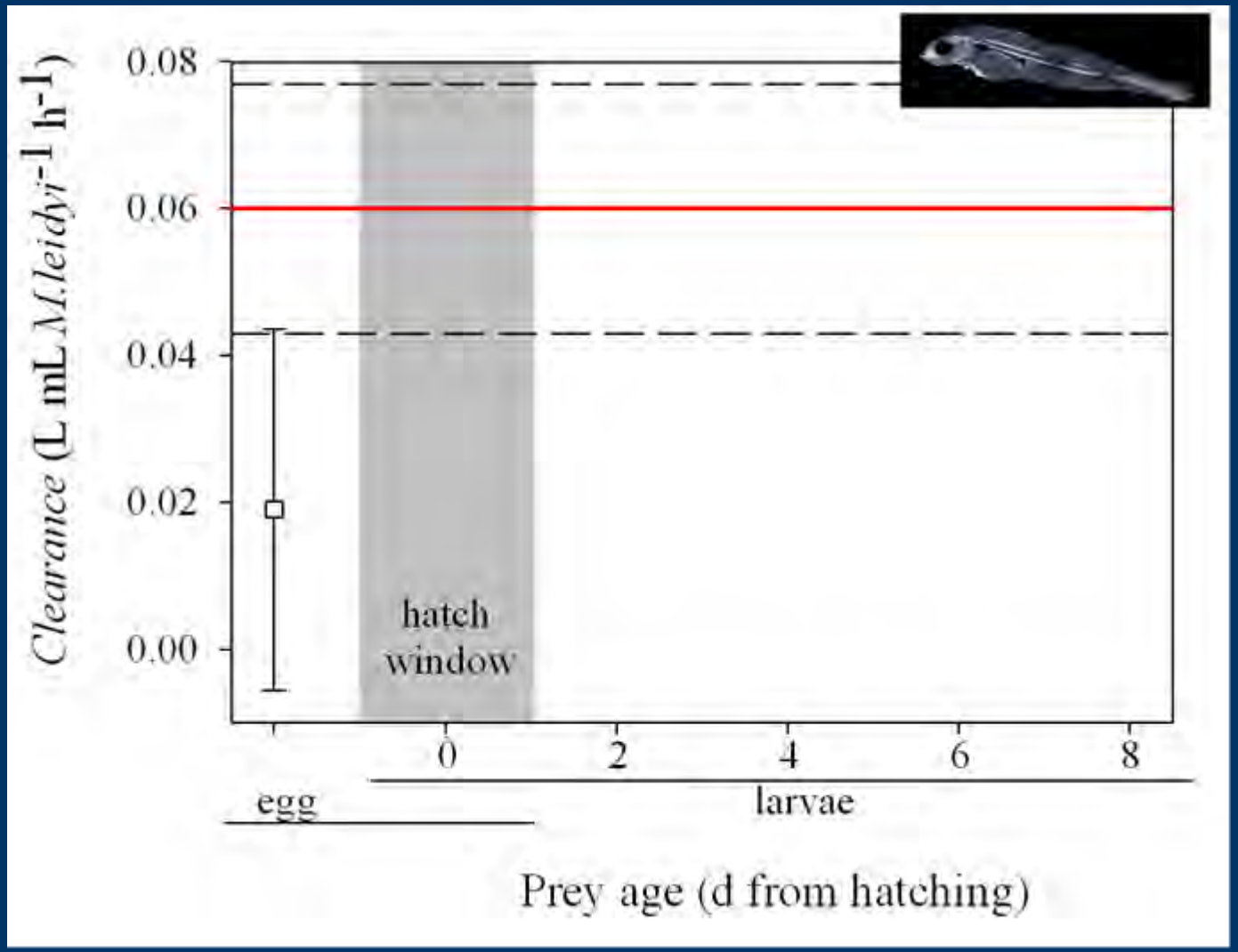
Magnification: Eggs 25x Larvae 12x

Volume-specific clearance as a function of prey age



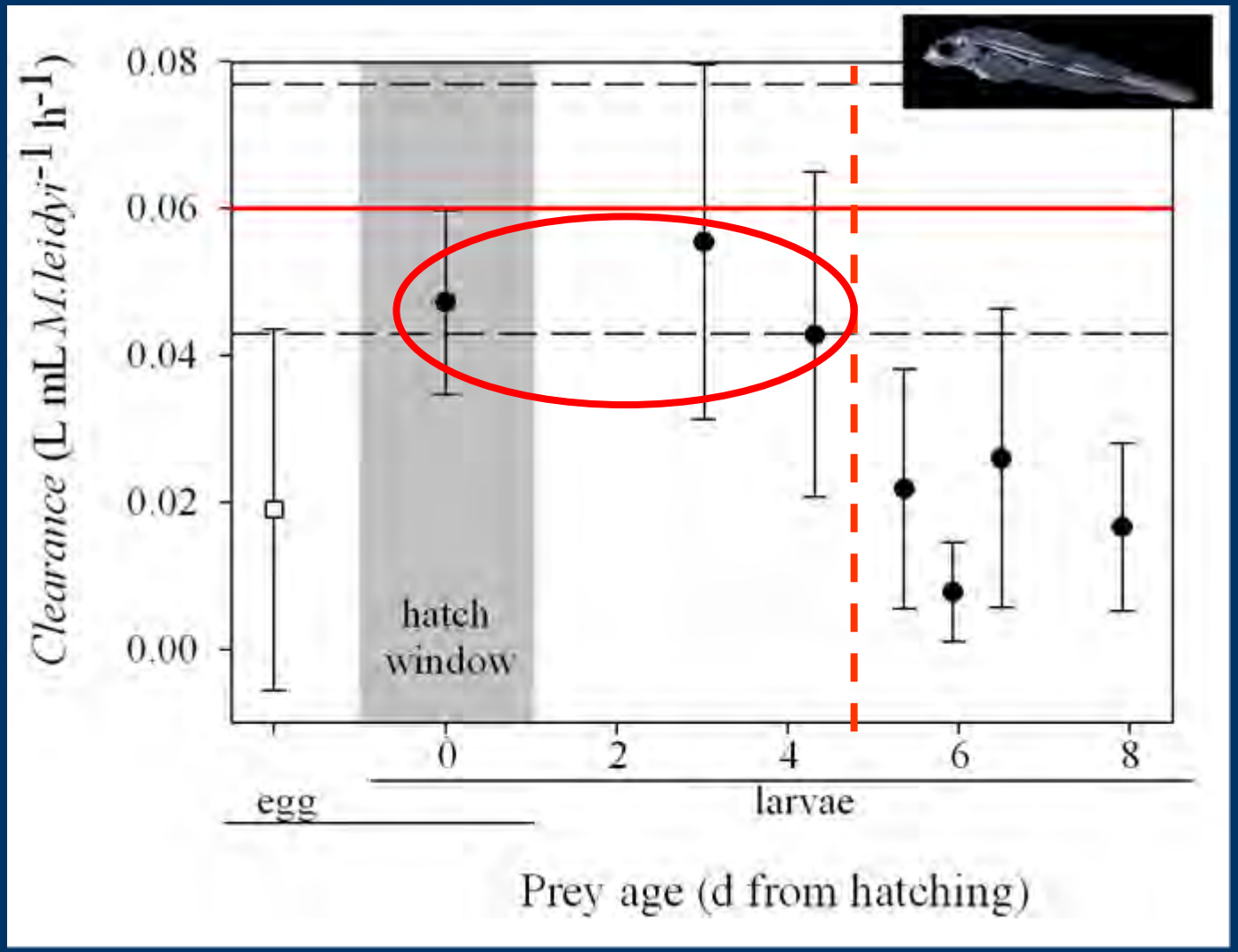
Jaspers et al. 2011 (L&O)

Volume-specific clearance as a function of prey age



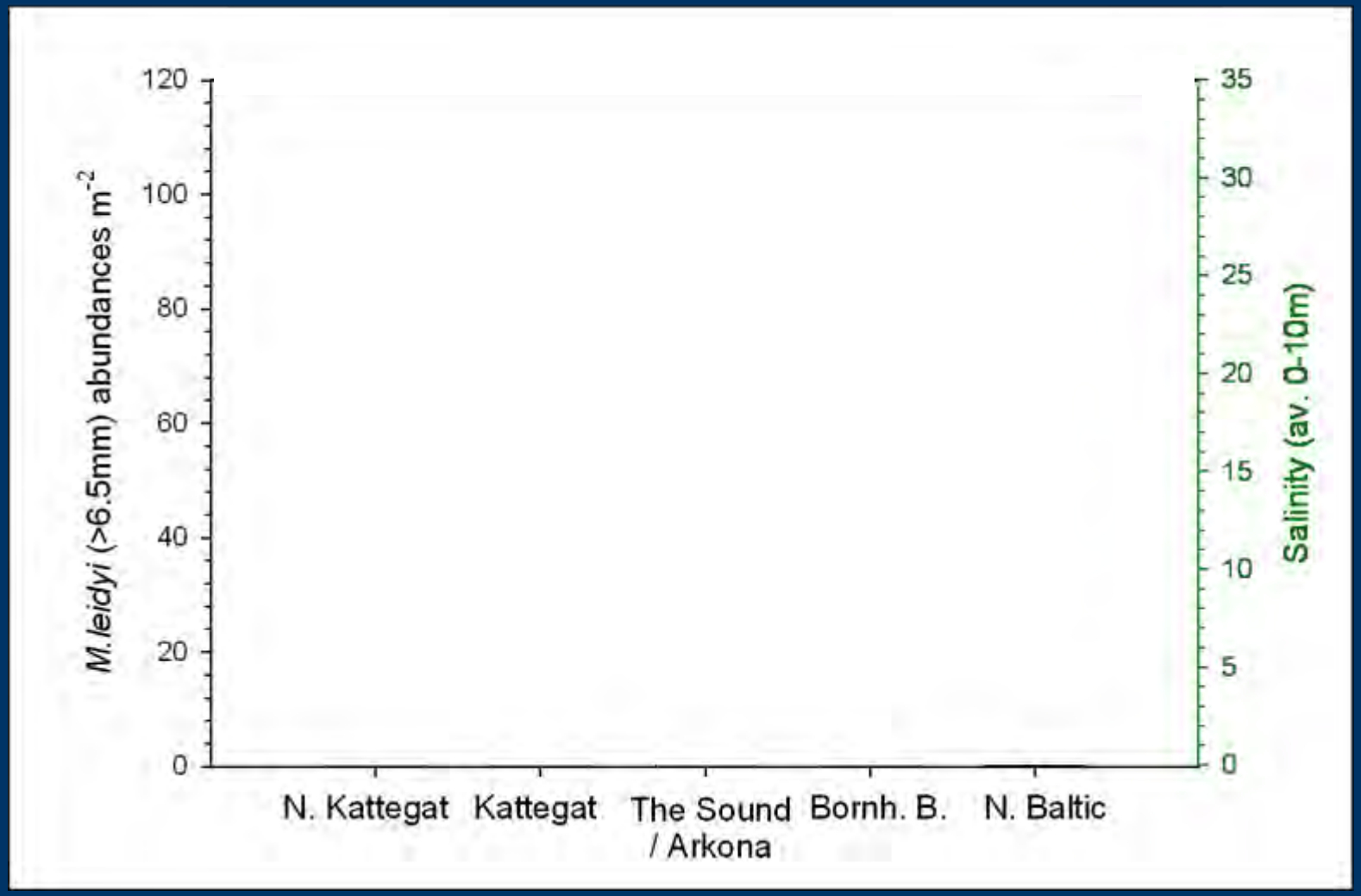
Jaspers et al. 2011 (L&O)

Volume-specific clearance as a function of prey age



Jaspers et al. 2011 (L&O)

Adult *M. leidyi* abundances



Jaspers et al. (in revision)

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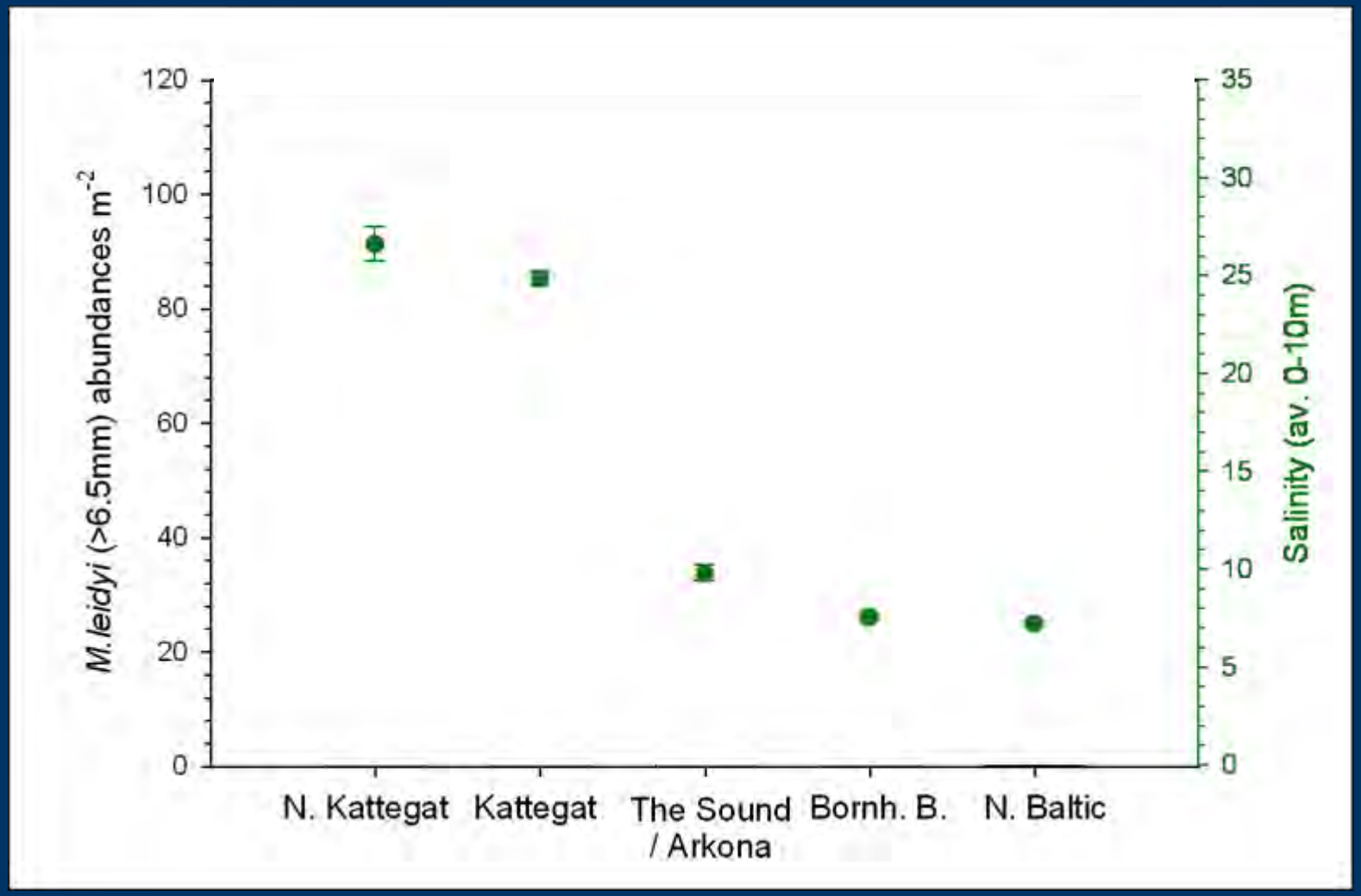

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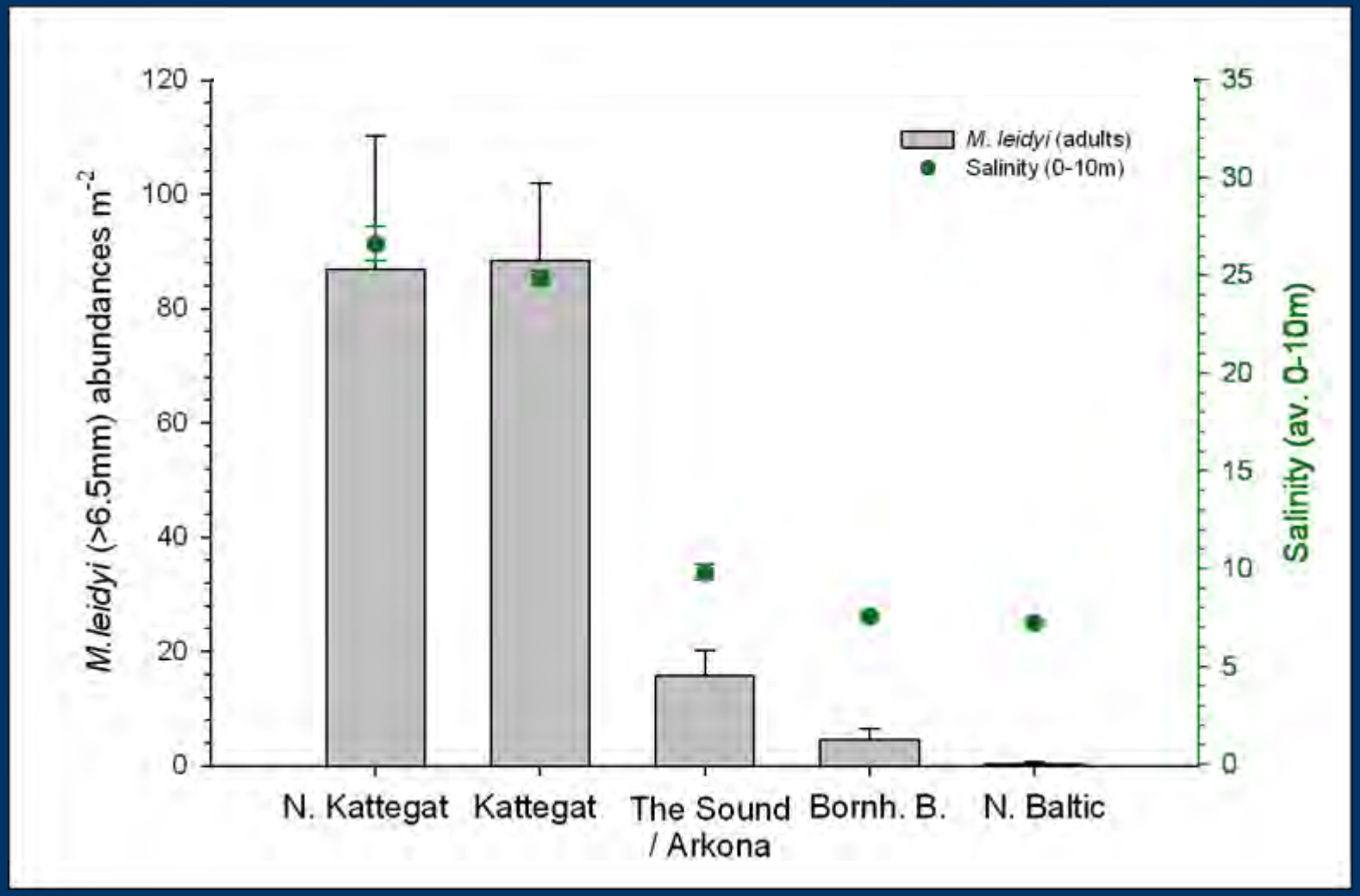

Jaspers et al. (in revision)

Summary

- Very low feeding rates at 7°C
- Passive negative selection of cod eggs
- Low abundances in the southern & central Baltic
- Applying clearance rates to field abundances:
  0.13% cod larvae and 0.05% cod eggs d^{-1}

$\Rightarrow$ No direct predation threat to Baltic cod recruits

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The invasive ctenophore *Mnemiopsis leidyi* poses no direct threat to Baltic cod eggs and larvae

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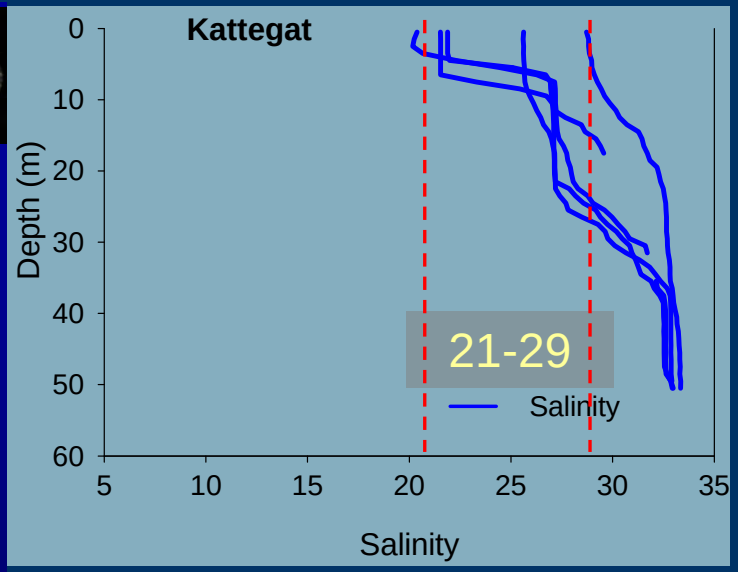
Objective II

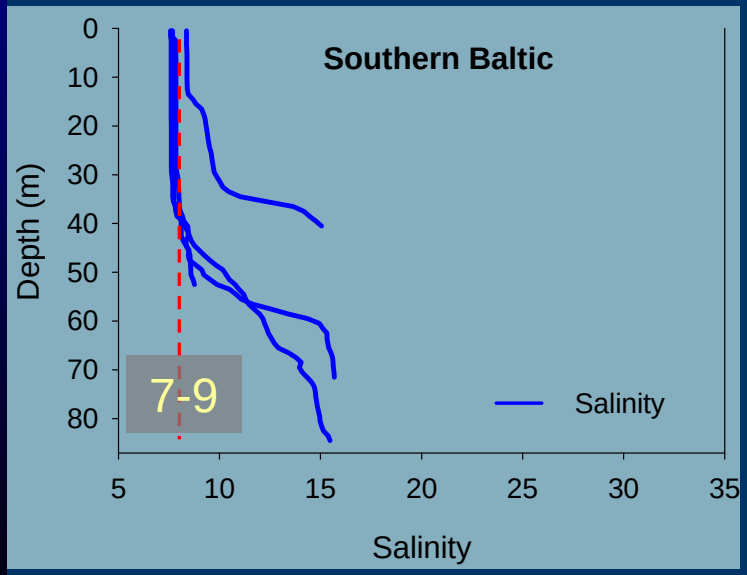
Understand the *in situ* reproduction of *M. leidyi* in the Baltic Sea

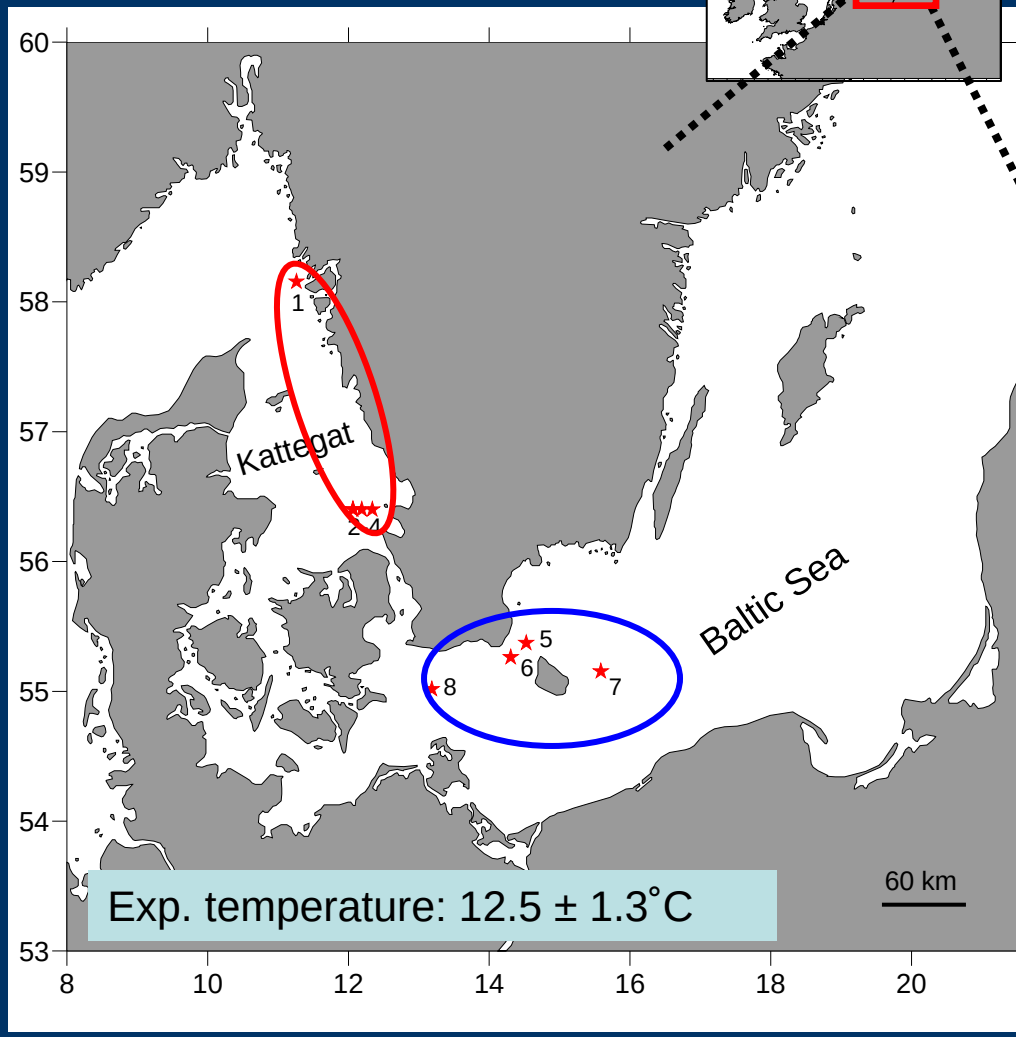
Due to the high reproductive capacity, *M. leidyi* could establish a large population in the central Baltic leading to food competition with cod recruits.

Indirect effect: Materials

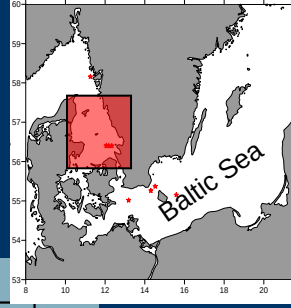
In situ reproduction rates

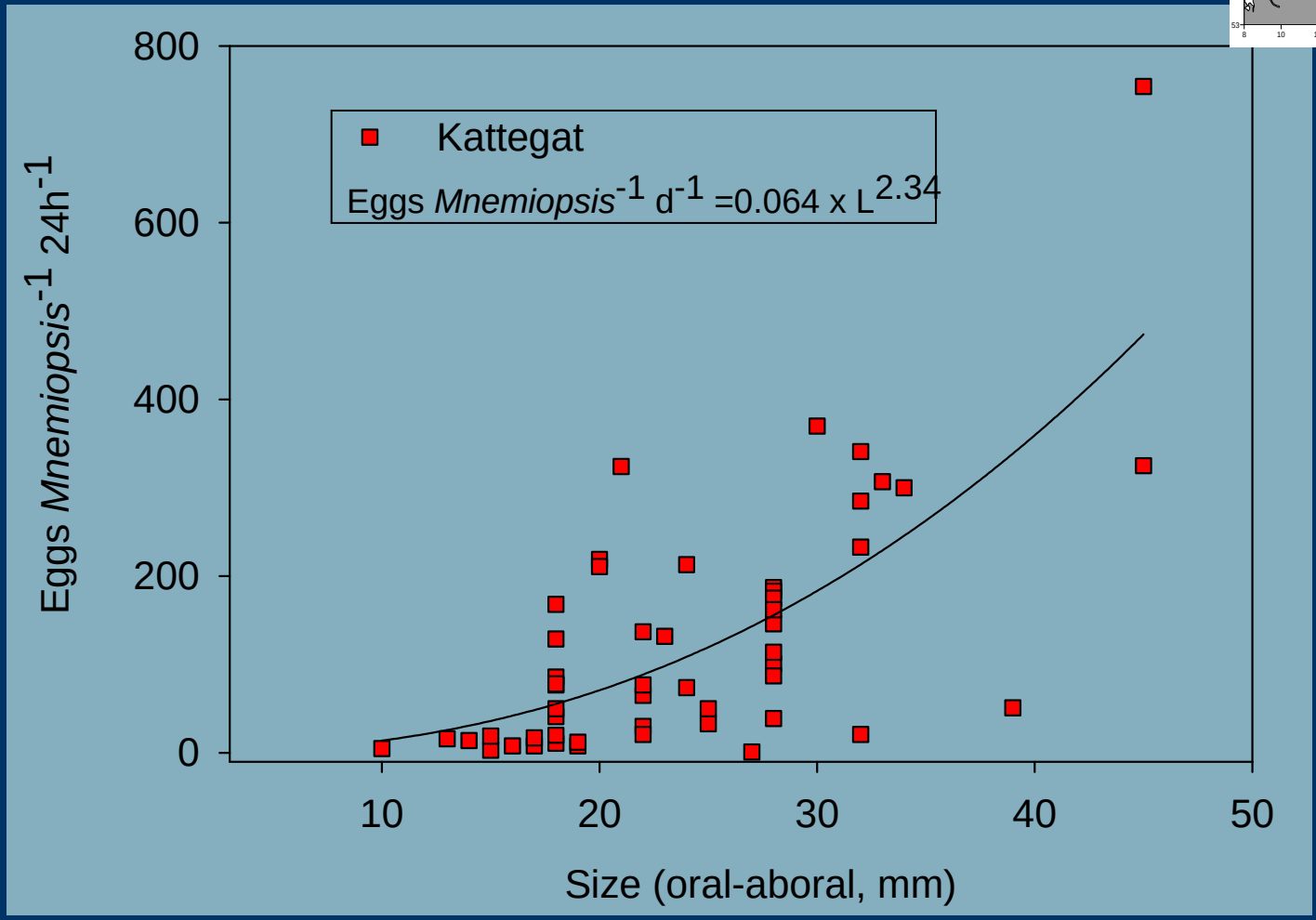






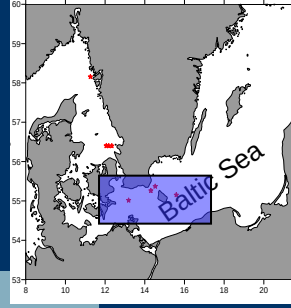
Size *vs.* egg production

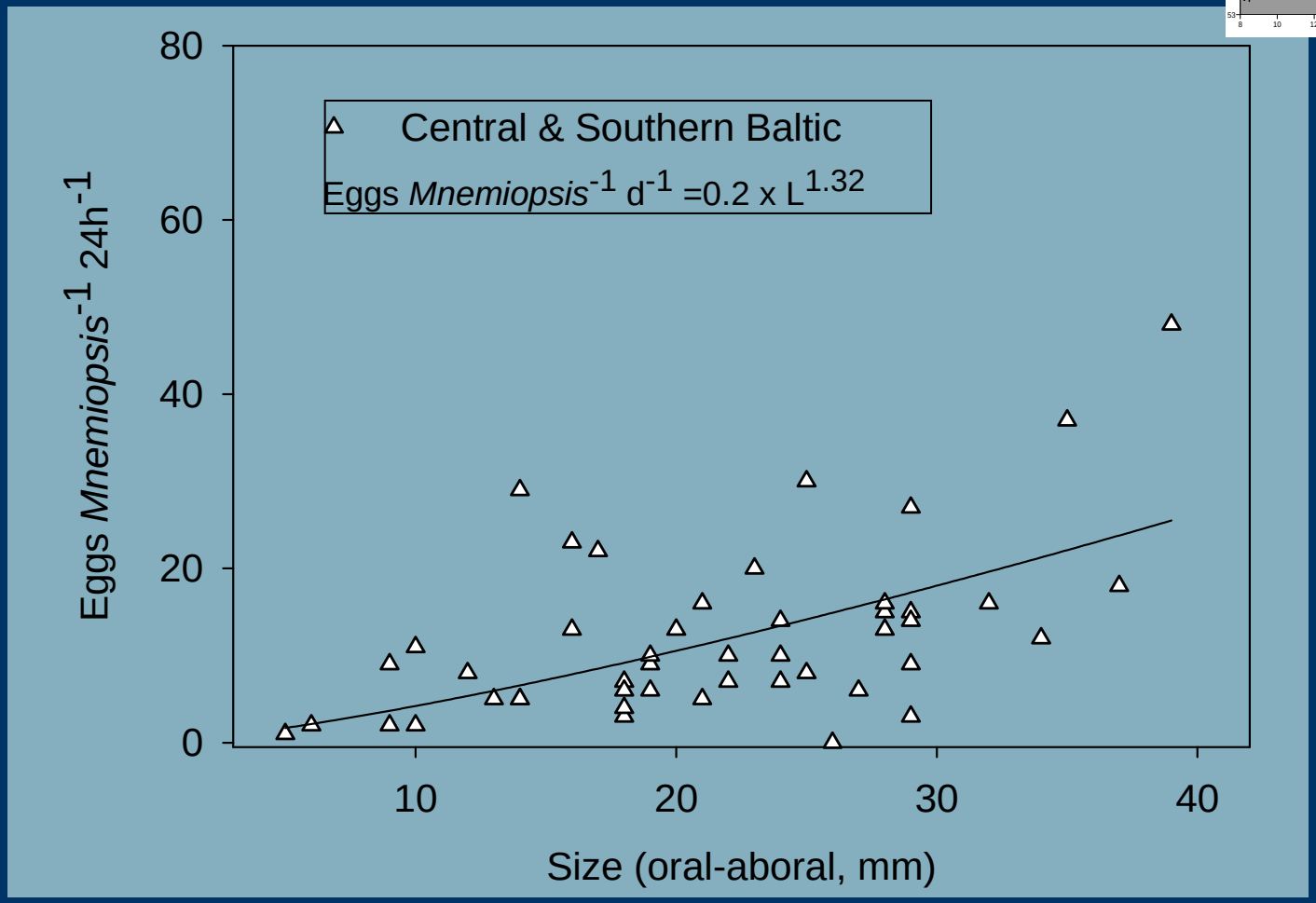




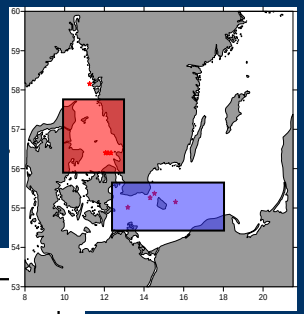
Indirect effect: Materials

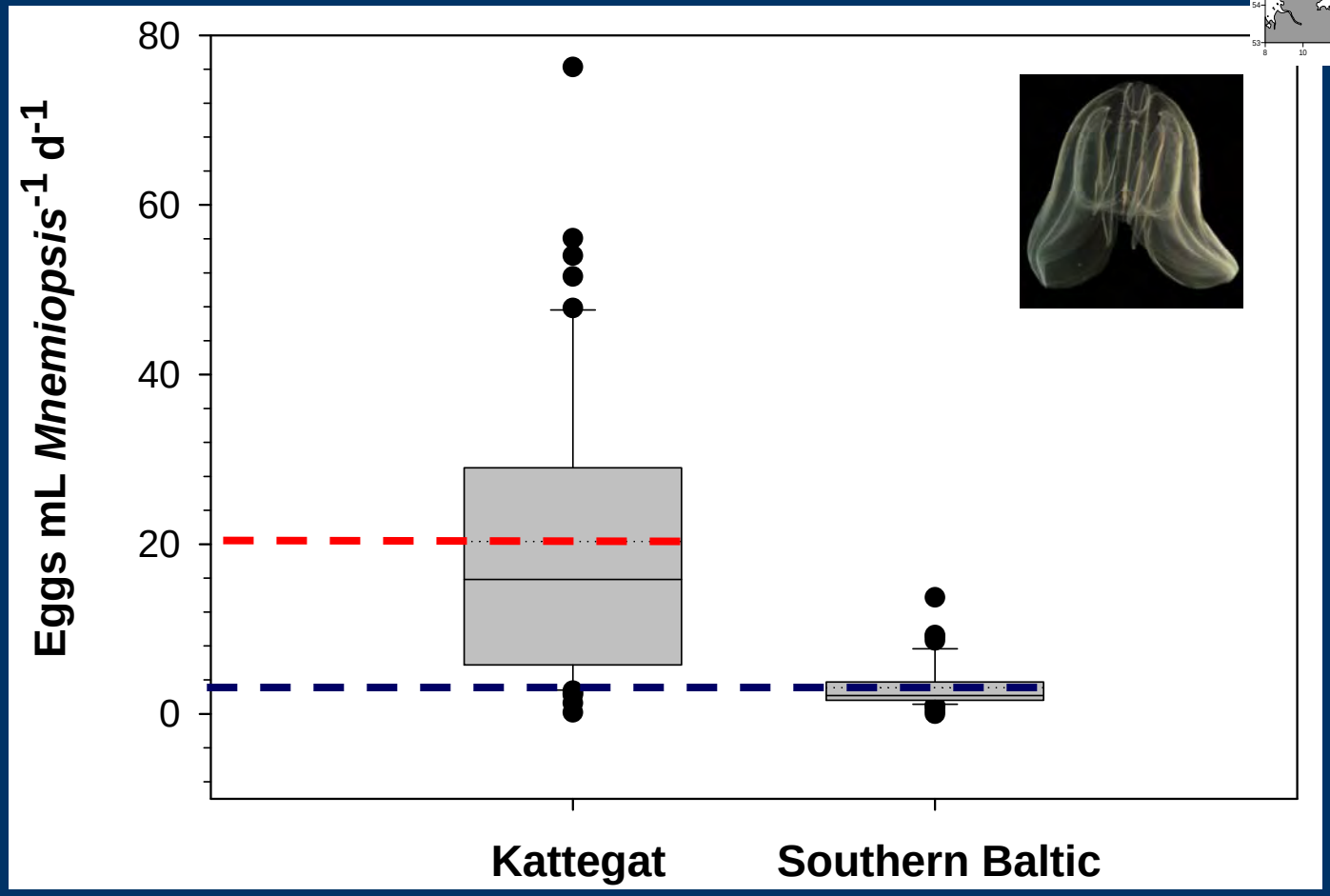
Size *vs.* egg production





In situ reproduction rates

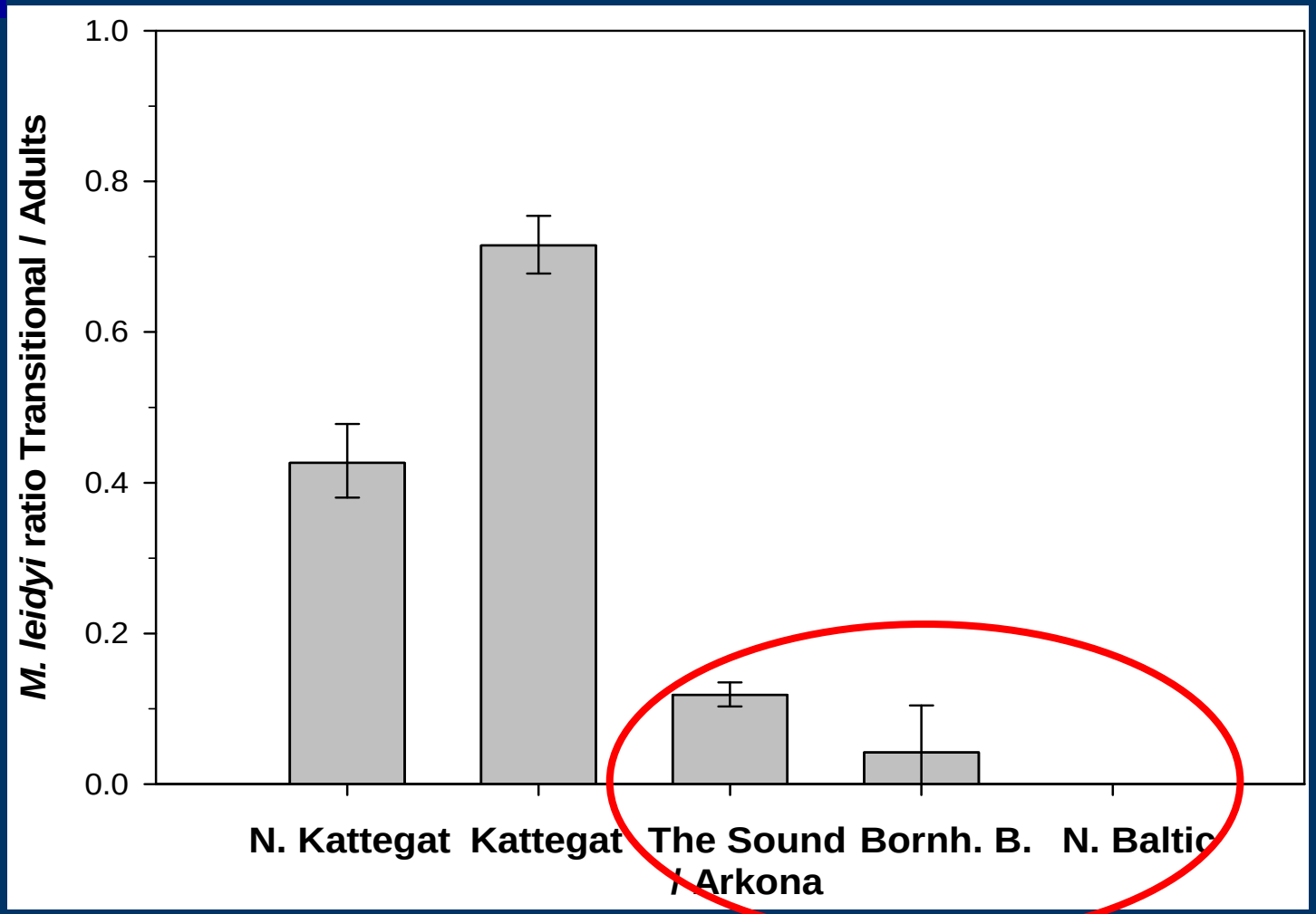




Zooplankton standing stock 6 times higher in the central Baltic

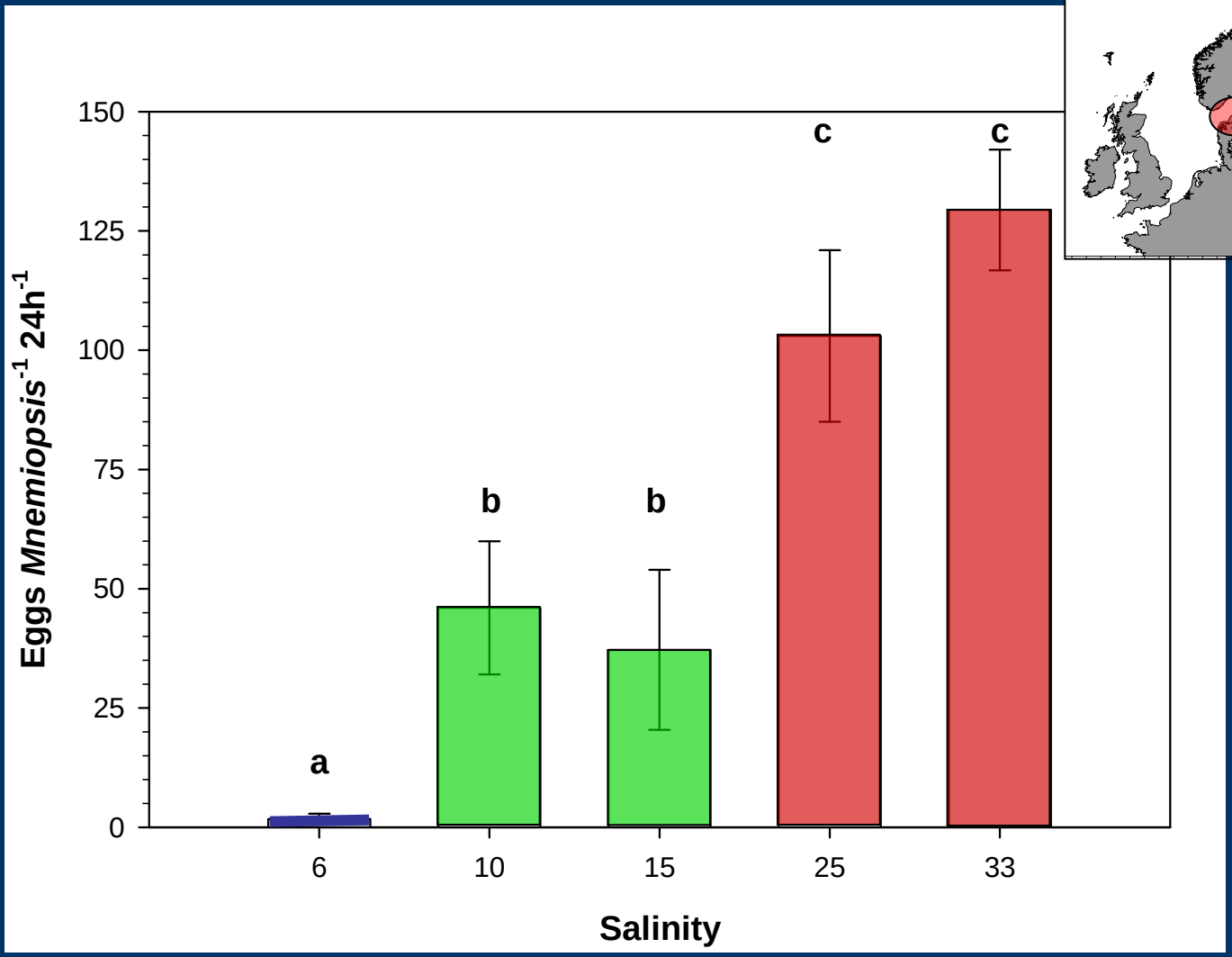
Jaspers et al. 2011 (PLoS ONE)

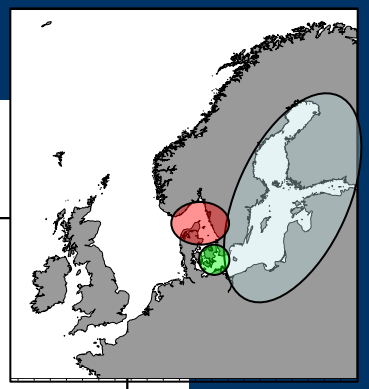
Population composition



Jaspers et al. (in revision)

Salinity dependent reproduction

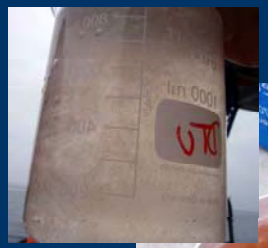


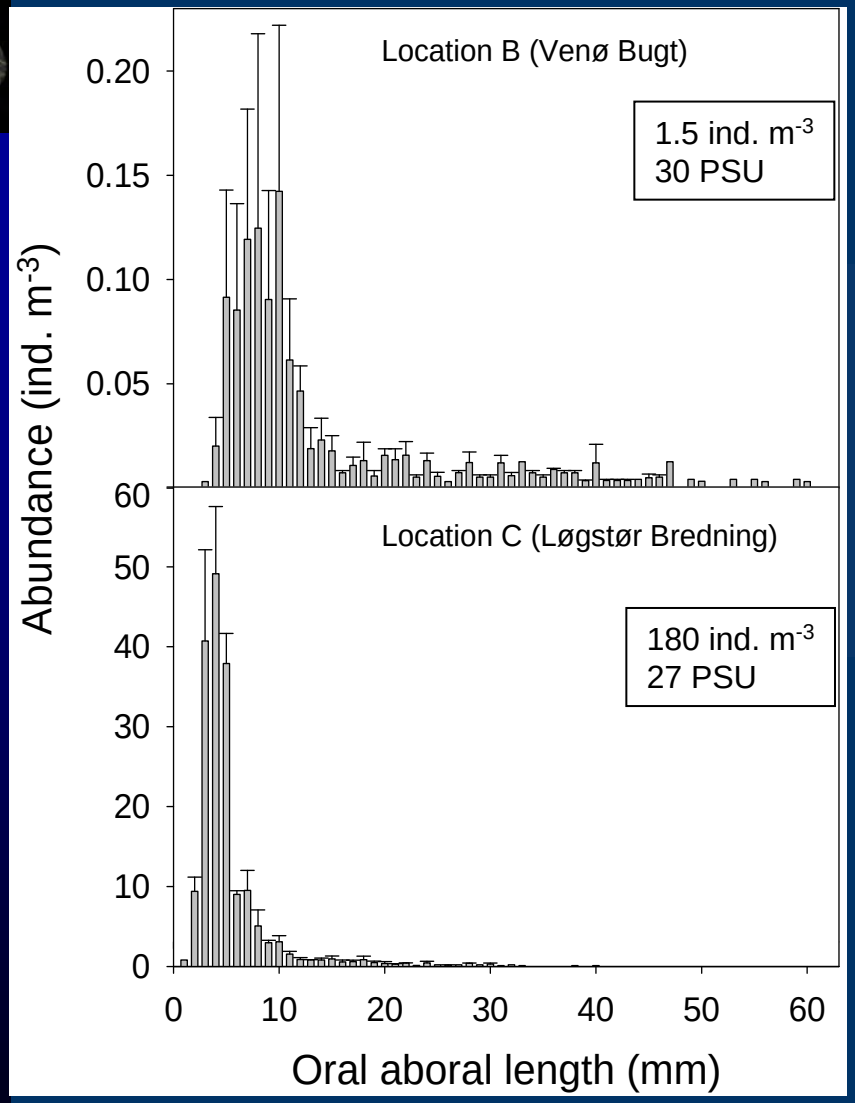


Jaspers et al. 2011 (PLoS ONE)

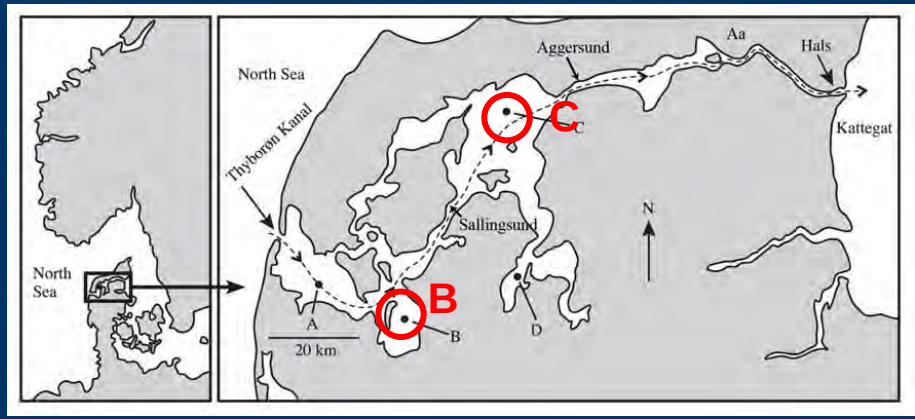
Example: High saline area

Limfjorden, Denmark



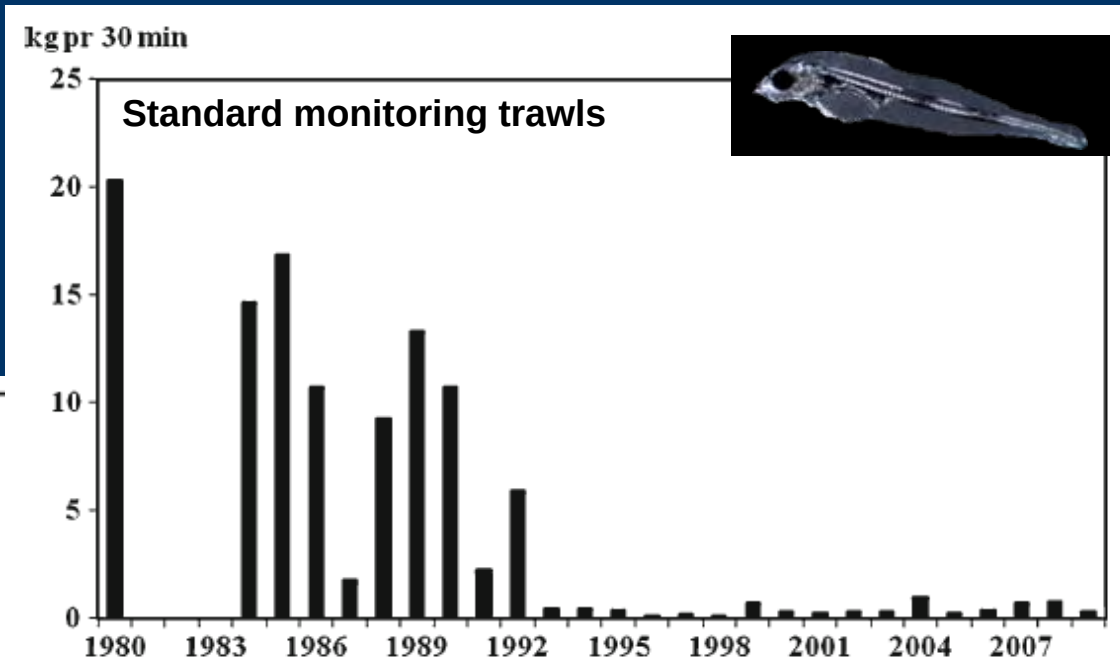


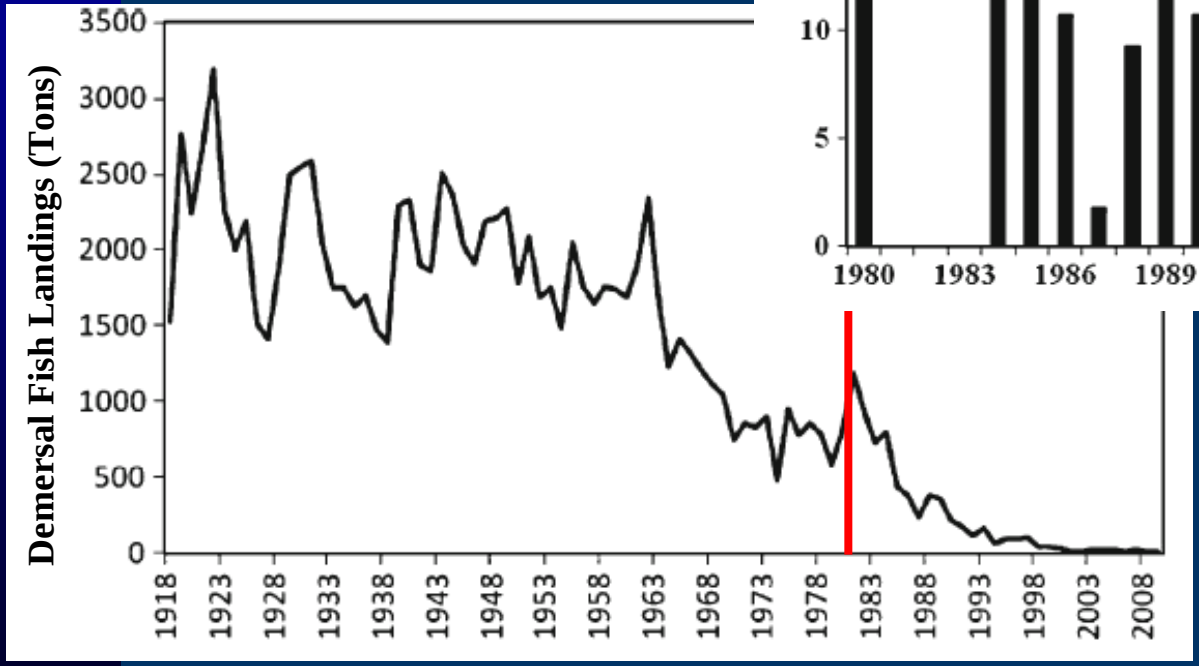
- Regular ”Jelly-Blooms”
- 600-800 *M. leidyi* m^{-3}
- Population development
- 11,500 eggs ind^{-1} d^{-1}
- Active recruitment



Riisgård, Jaspers et al. (2012)

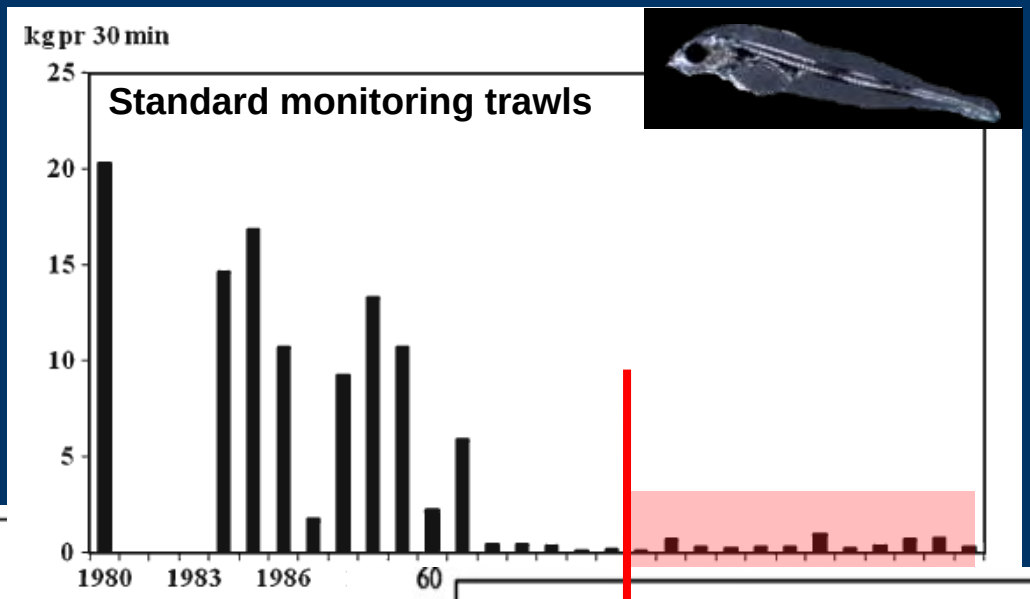
Limfjorden, Fisheries

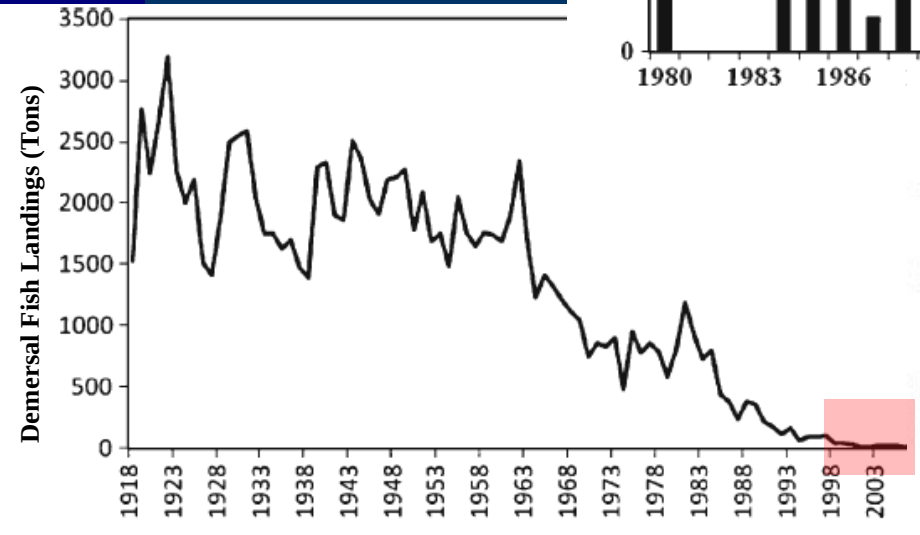


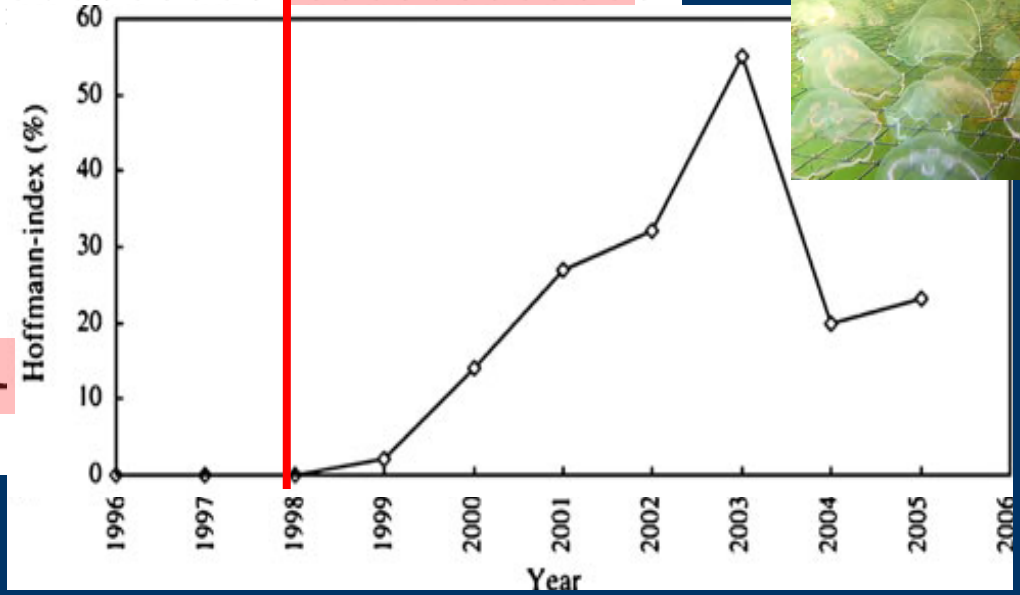


Riisgård, Andersen, Hoffmann (2012)

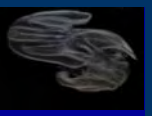
Limfjorden, Fisheries





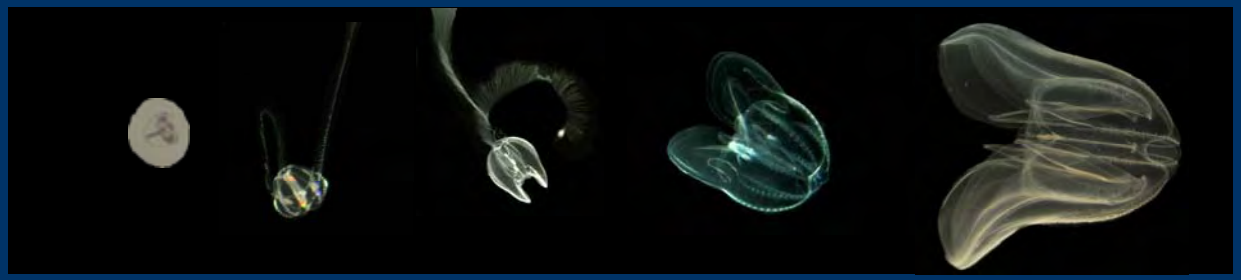


Riisgård, Andersen, Hoffmann (2012)



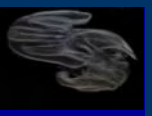
Mnemiopsis leidyi

- Up to now *M. leidyi* is neither a direct nor an indirect problem for fisheries in the central Baltic
- Potential & documented problem in high saline areas (e.g. Limfjorden, Kattegat)

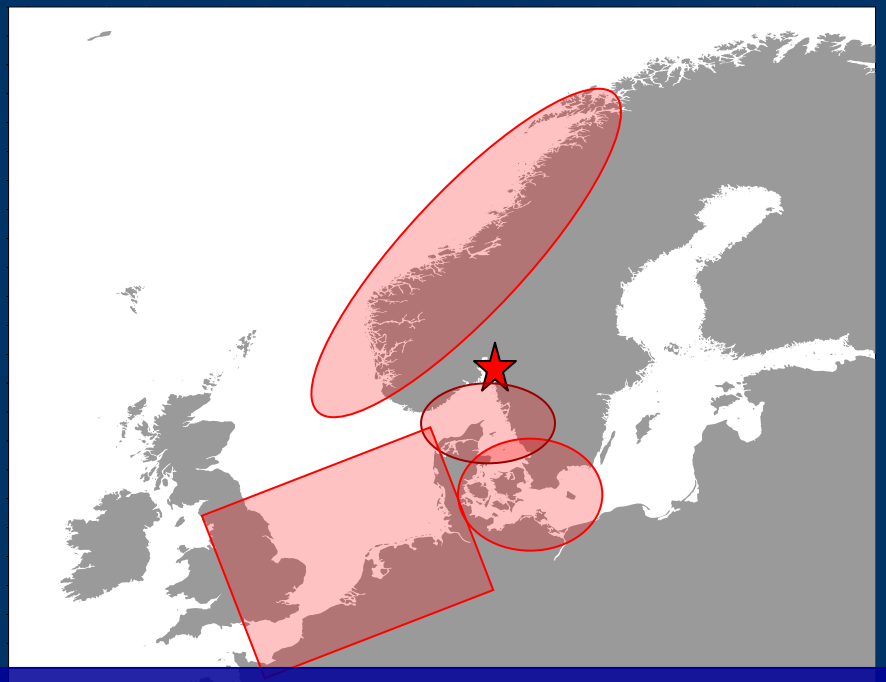


Conclusion & implications

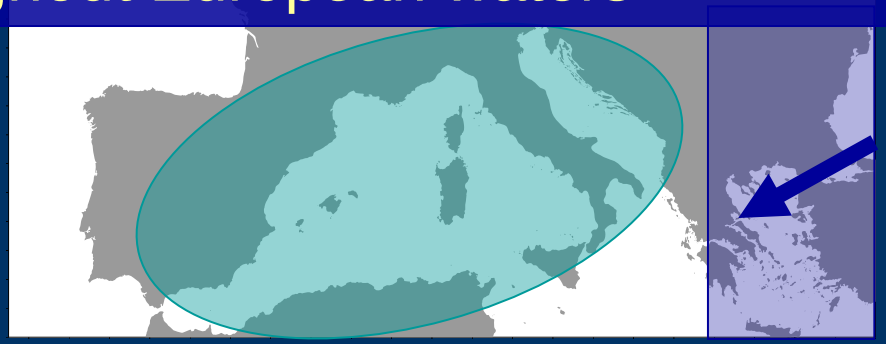
M. leidyi in European waters



2005 first record in northern Europe (Oliveira 2007)



⇒ *M. leidyi* established throughout European waters



Conclusion & implications

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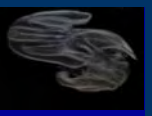


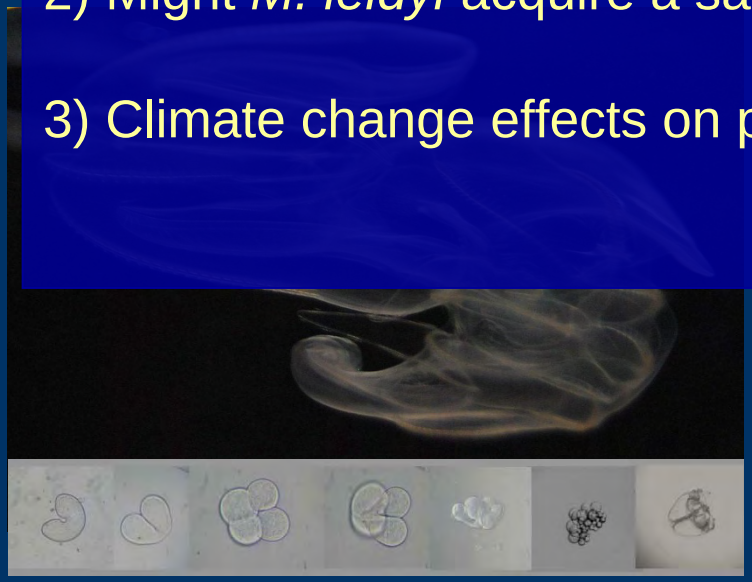
2005 first recorded in northern Europe (Oliveira 2007)

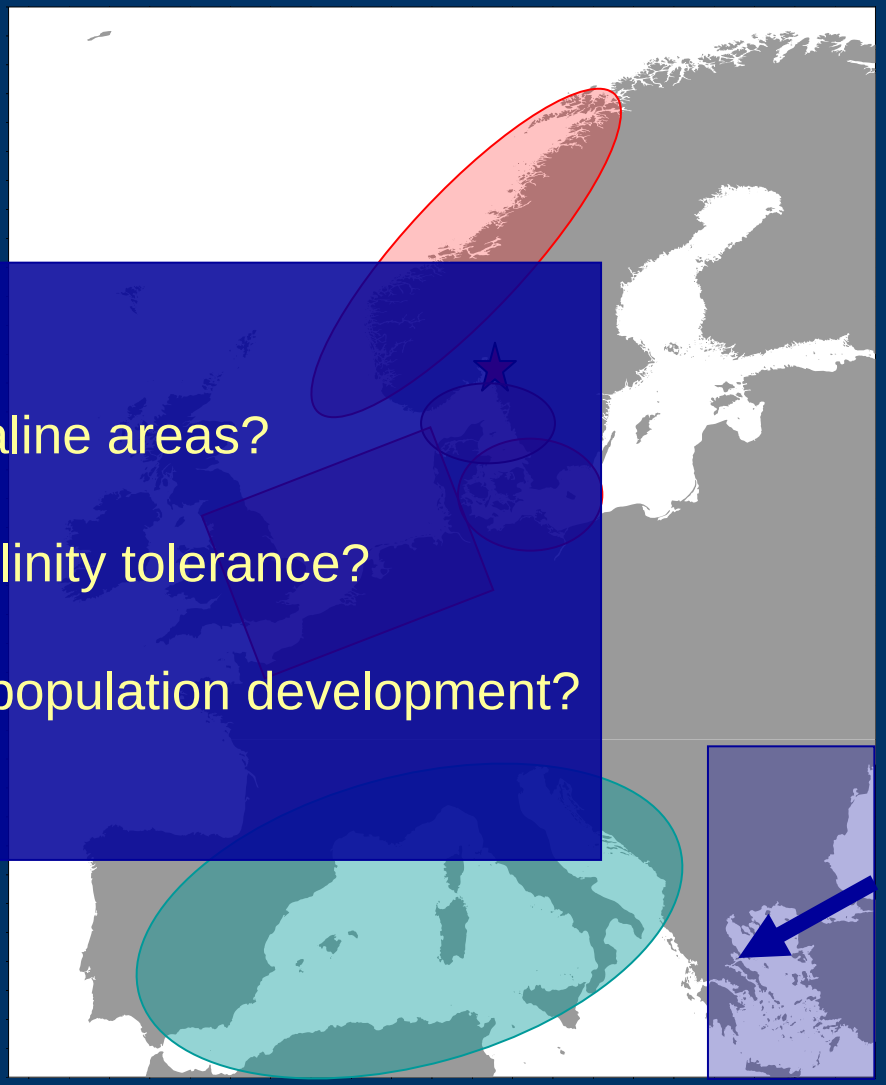
Questions arise:

1) Long term impact in high saline areas?

2) Might *M. leidyi* acquire a salinity tolerance?

3) Climate change effects on population development?





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Aino Hosia, Institute of Marine Research, Norway

ICES CIEM

DAAD Deutscher Akademischer Austausch Dienst German Academic Exchange Service

BONUS Baltic Organisations Network for Funding Science EEIG

nma Nordic Marine Academy

ASSEMBLE ASSOCIATION OF EUROPEAN MARINE BIOLOGICAL LABORATORIES

SEVENTH FRAMEWORK PROGRAMME

Danish Agency for Science Technology and Innovation Ministry of Science Technology and Innovation

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Thank you
for your attention!