SMILE – you're on candid camera

Imaging and AI in zooplankton studies

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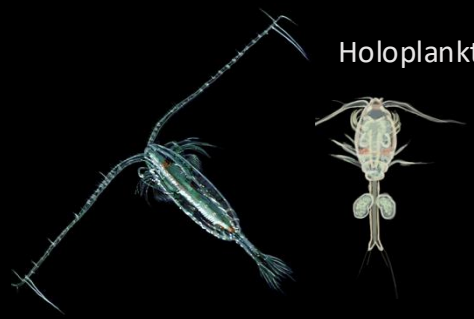
Plankton pics: plankton.photography

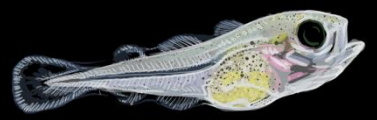
Zooplankton in the North Sea food web

Phytoplankton

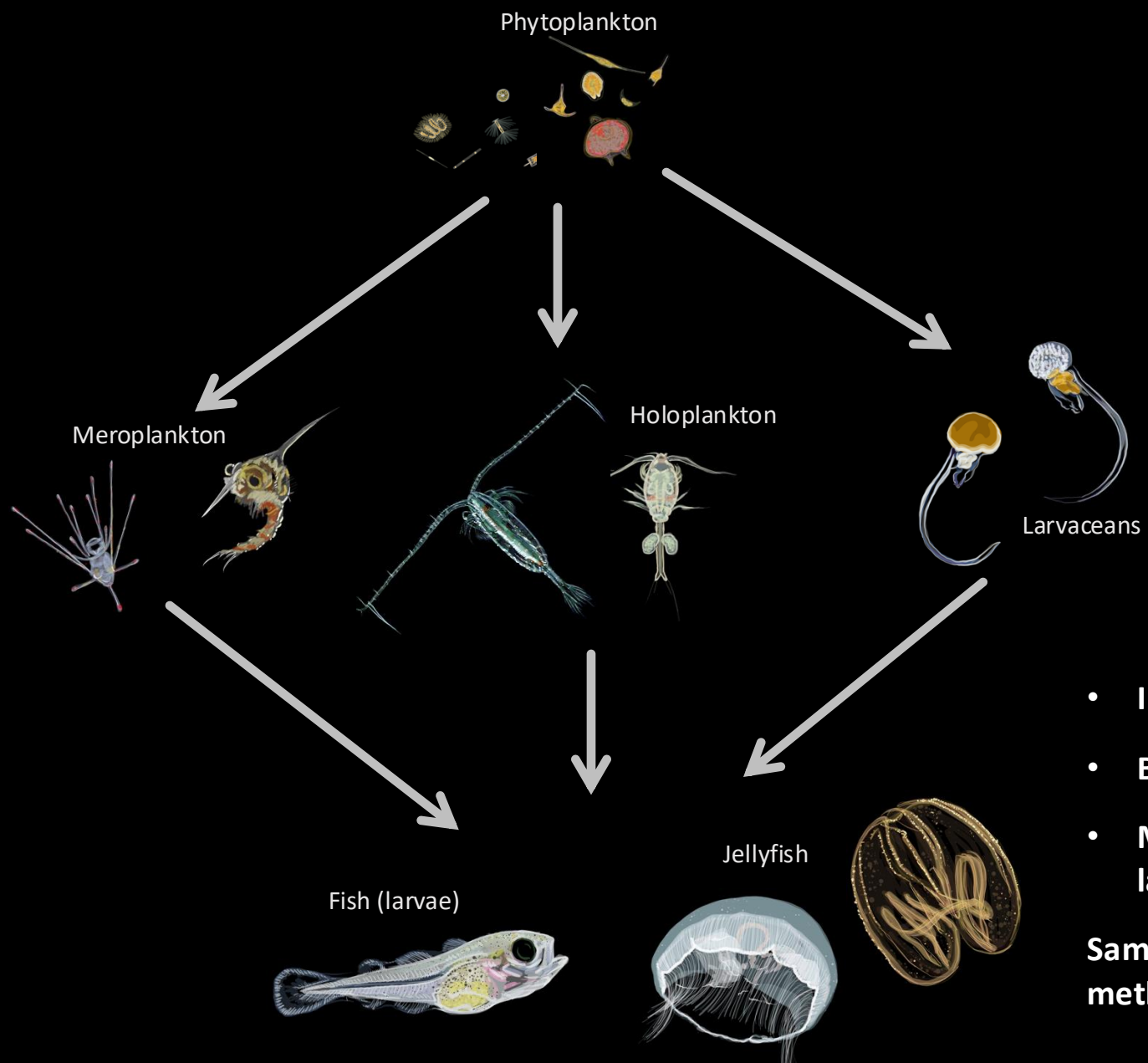


Holoplankton

Fish (larvae)



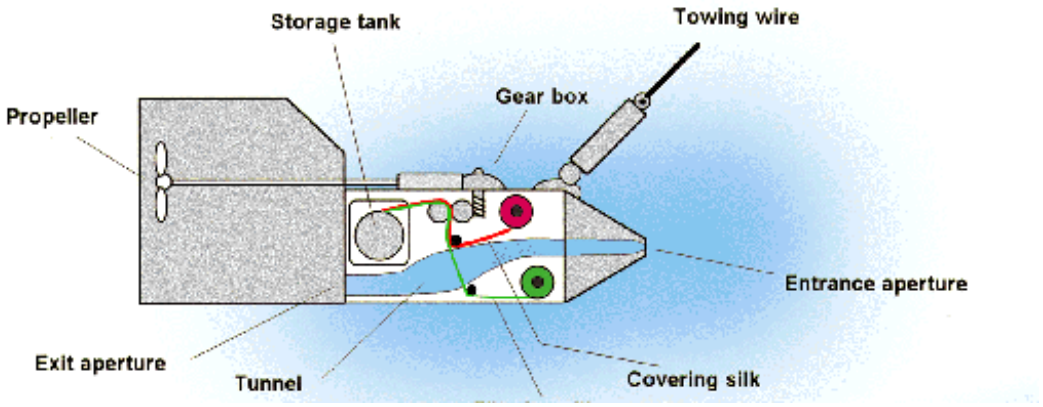
Multitrophic pelagic North Sea food web

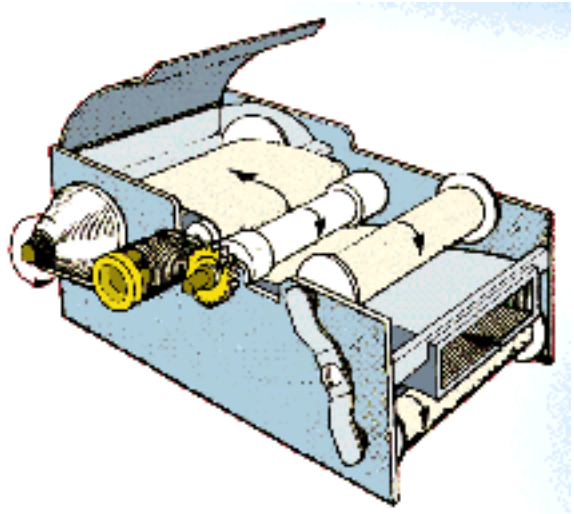


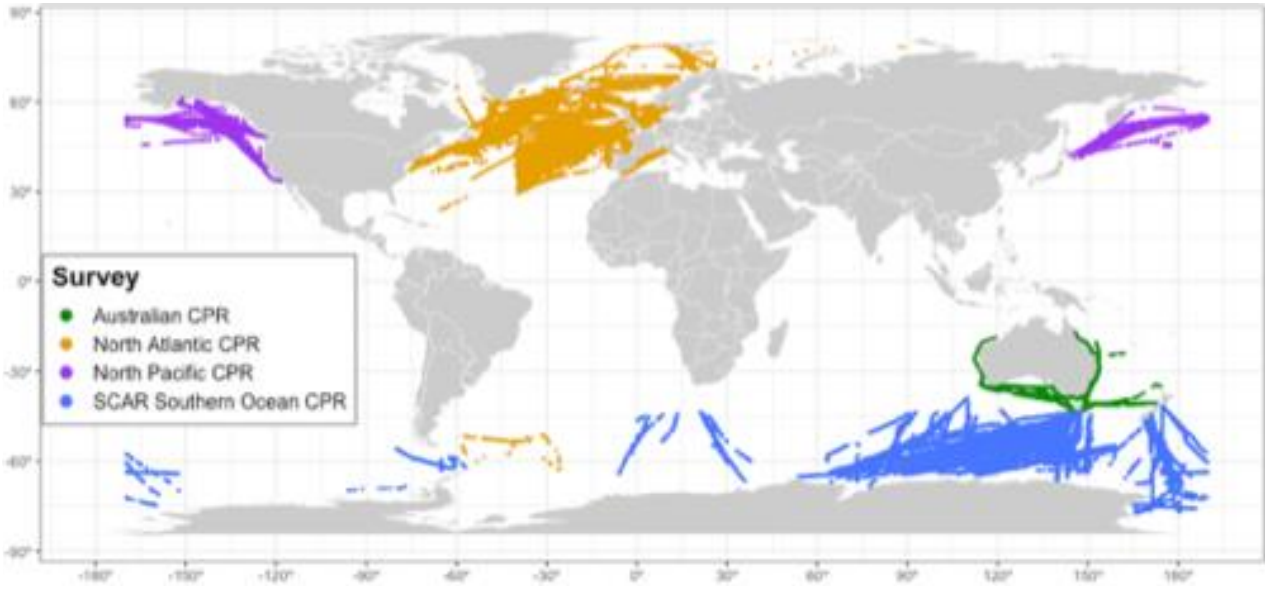
- **Important link in the food web**
- **Biological carbon pump**
- **Many benthic organisms have a larval stage**

Sampling is limited (costly) and methodologically difficult

Continuous plankton recorder (CPR)





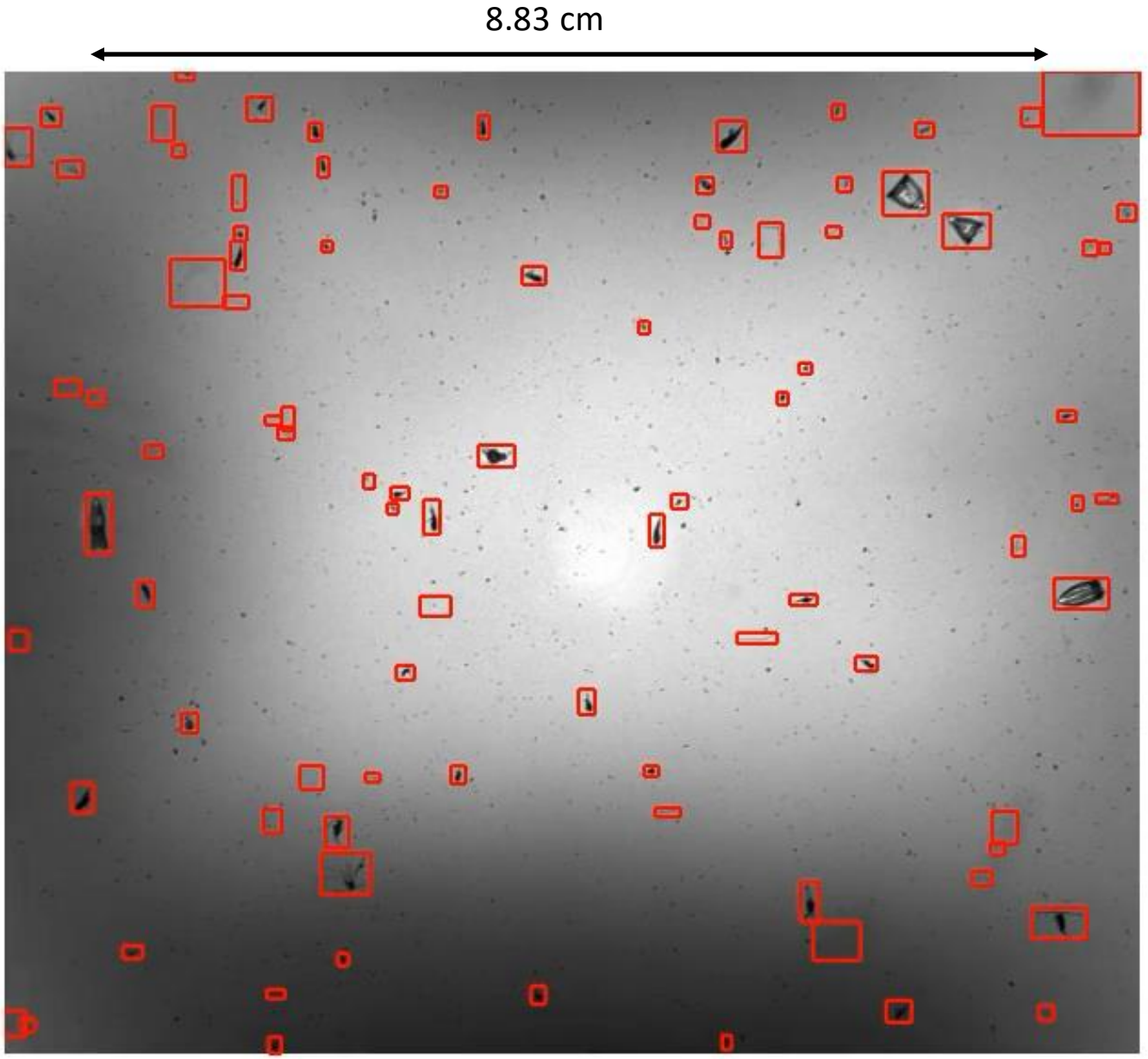


- No depth info
- Time-consuming
- No coastal data
- Sampling bias
- Gelatinous taxa missing

Three plankton imaging case studies:

- In situ imaging – Doggersbank
- On-board imaging – Coastal North Sea
- Mobile imaging – in development

In situ imaging – Doggersbank



Deployment time:	0:00:00
Number of frames:	1
Megabytes:	24.5
Number of image segments:	90

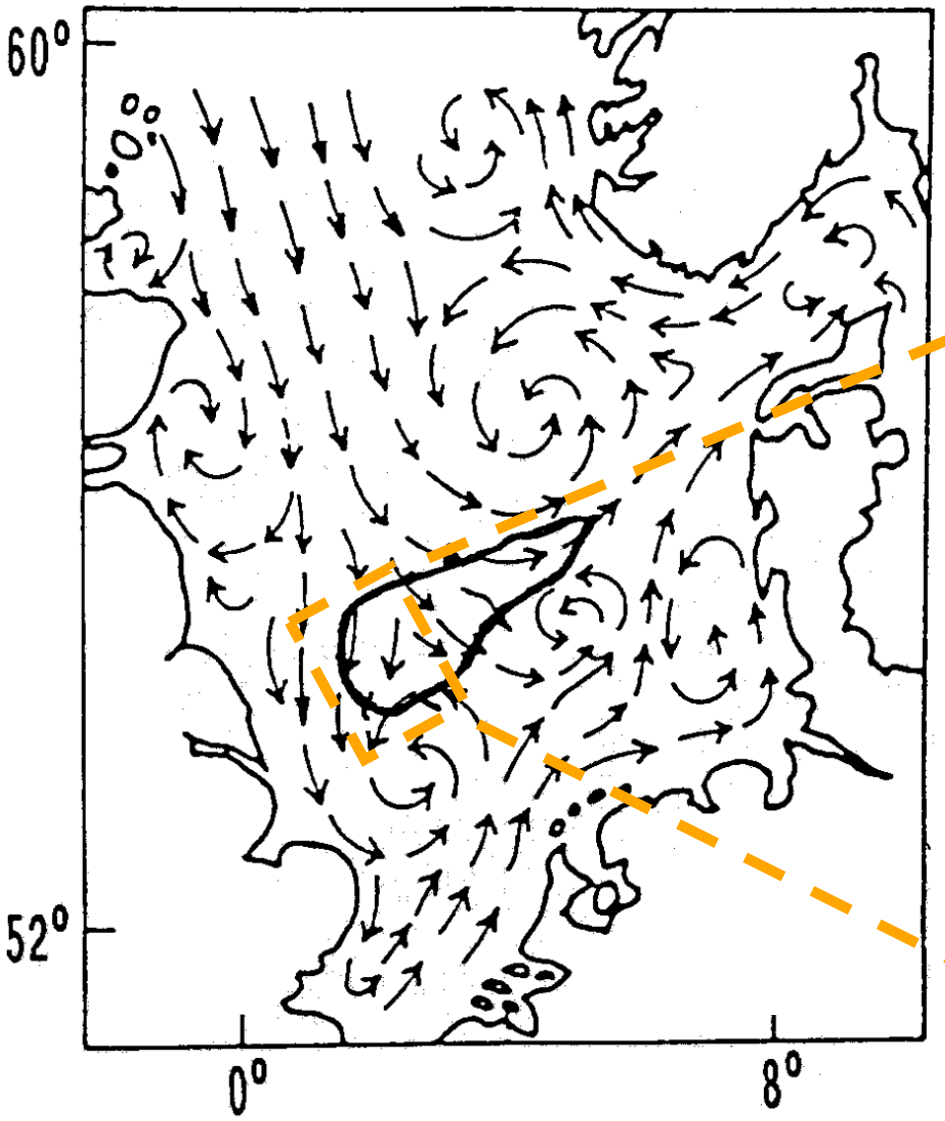
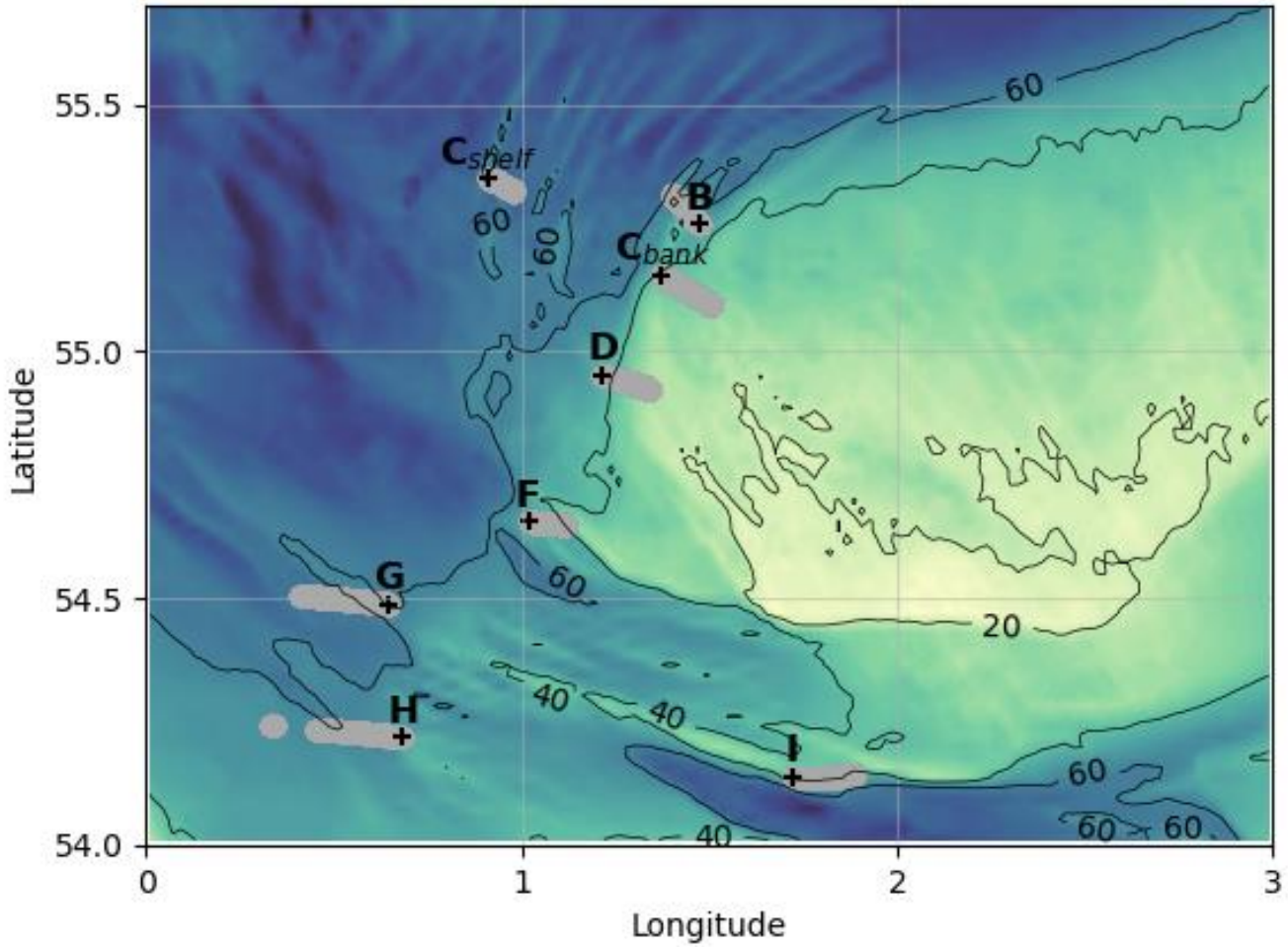
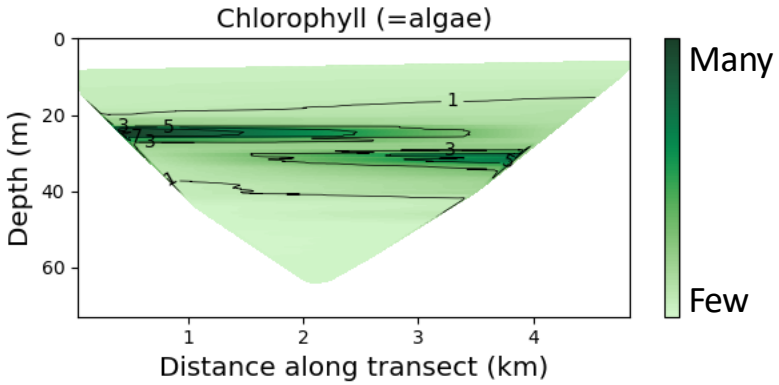


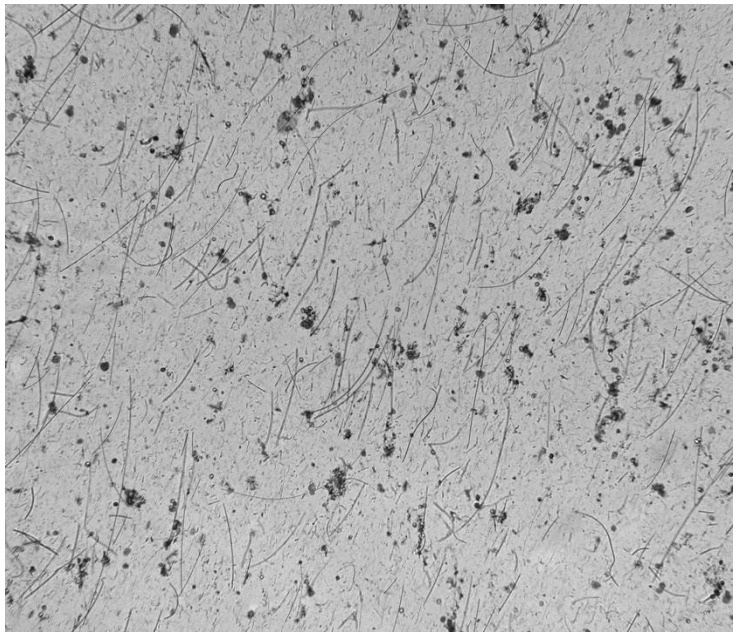
Figure from Kröncke & Knust, 1995

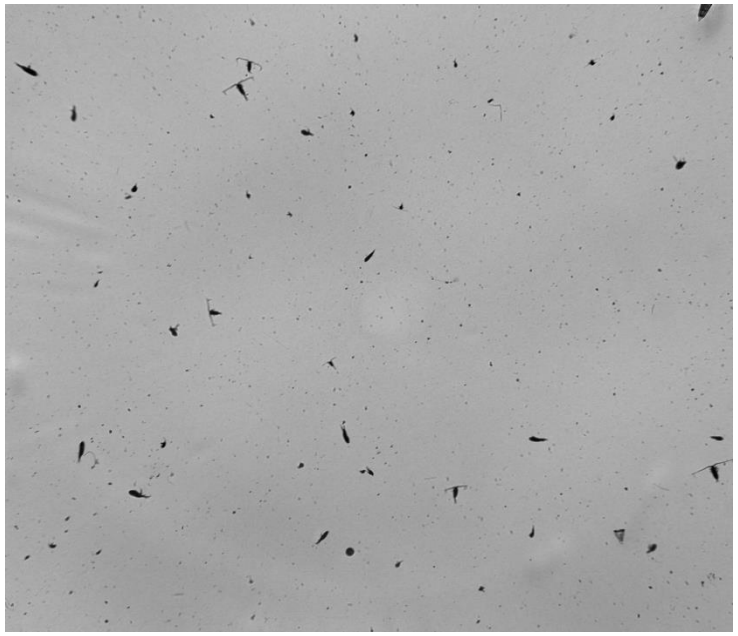
72 million segments



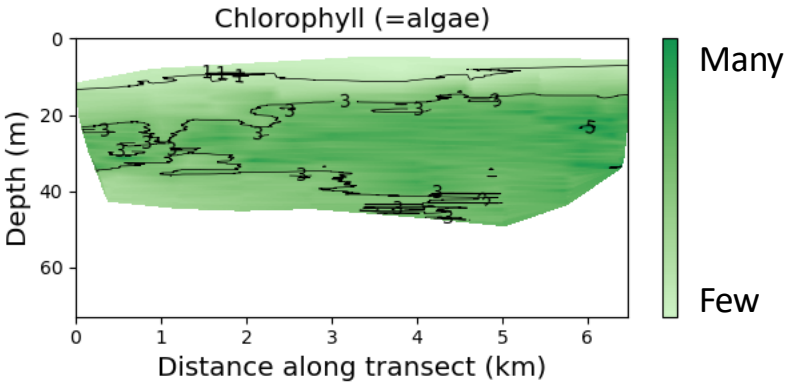
Sharp chlorophyll maximum







Mixed chlorophyll-a layer

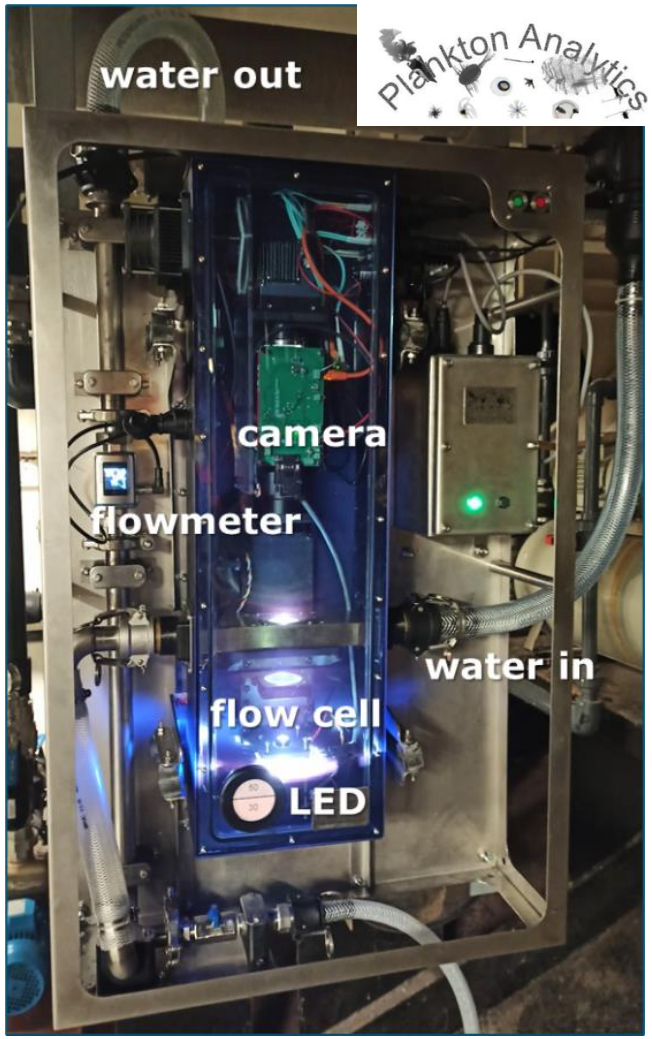


Three plankton imaging case studies:

- In situ imaging – Doggersbank
- On-board imaging – Coastal North Sea
- Mobile imaging – in development

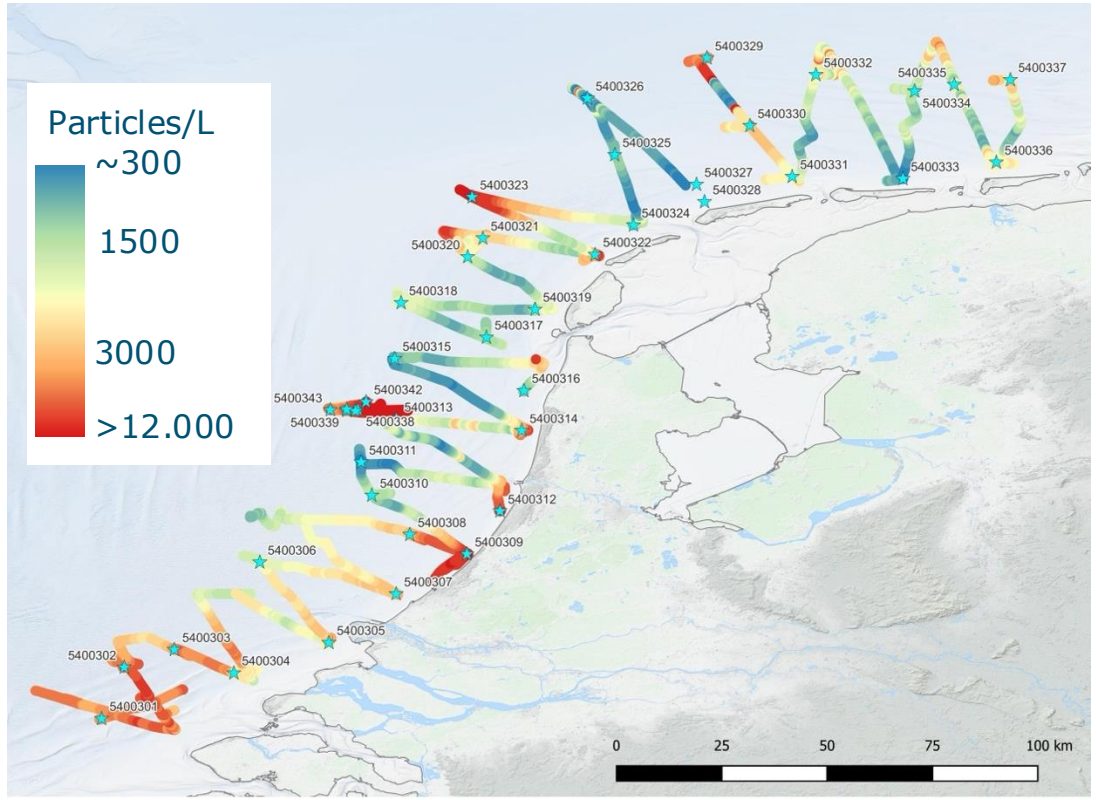
On-board imaging – Coastal North Sea

- Plankton Imager (PI10) developed by Plankton Analytics with CEFAS
- Autonomous and continuous underway sampling of mesoplankton composition
- Does not interfere with ship operations



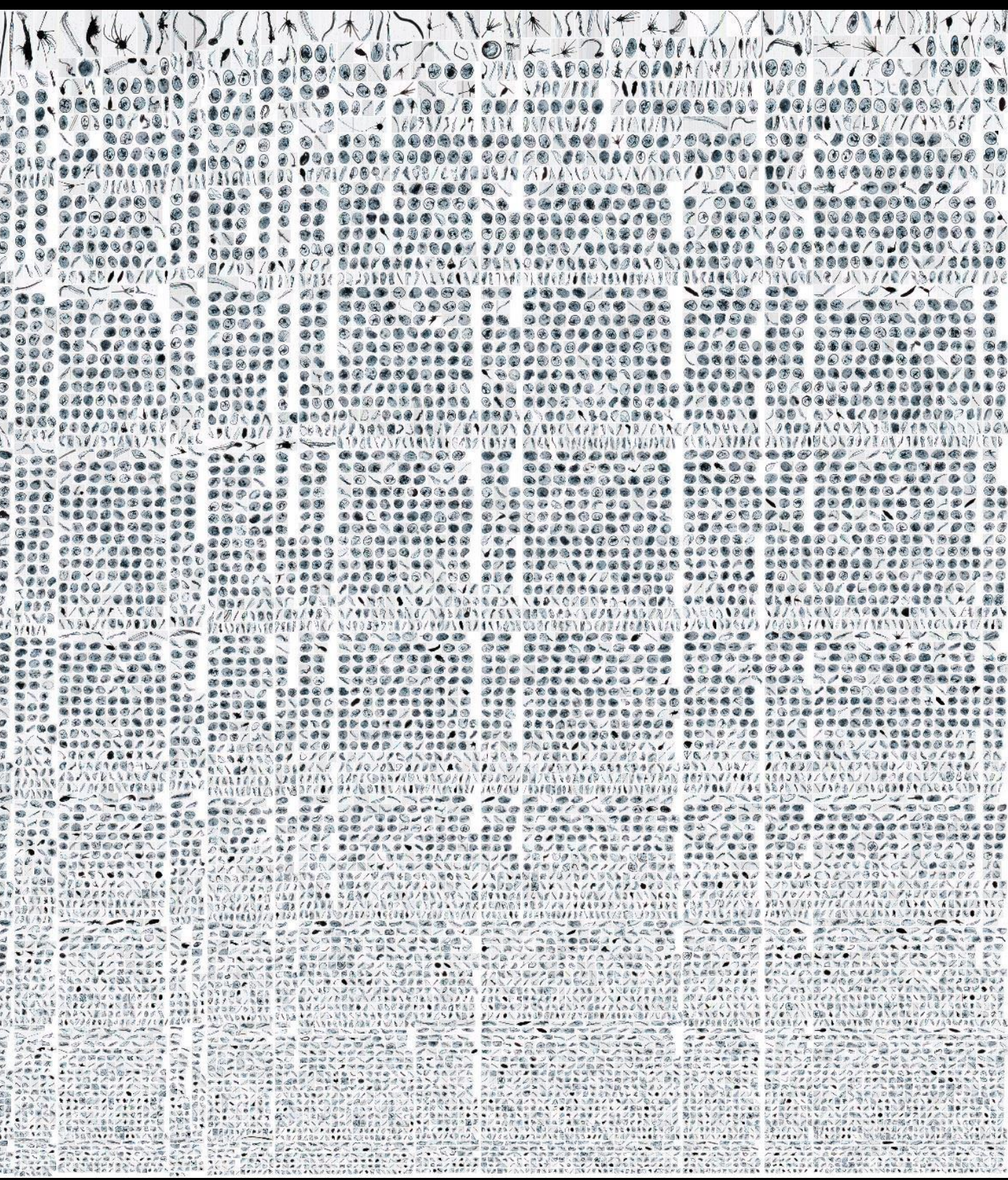
On-board imaging – Coastal North Sea

- MONS cruise with R/V Tridens
- Continuous sampling along the transect
  - 149 hours
  - 980 nm
  - 1.125 billion particles detected
  - 86 million images stored (7.6 %)



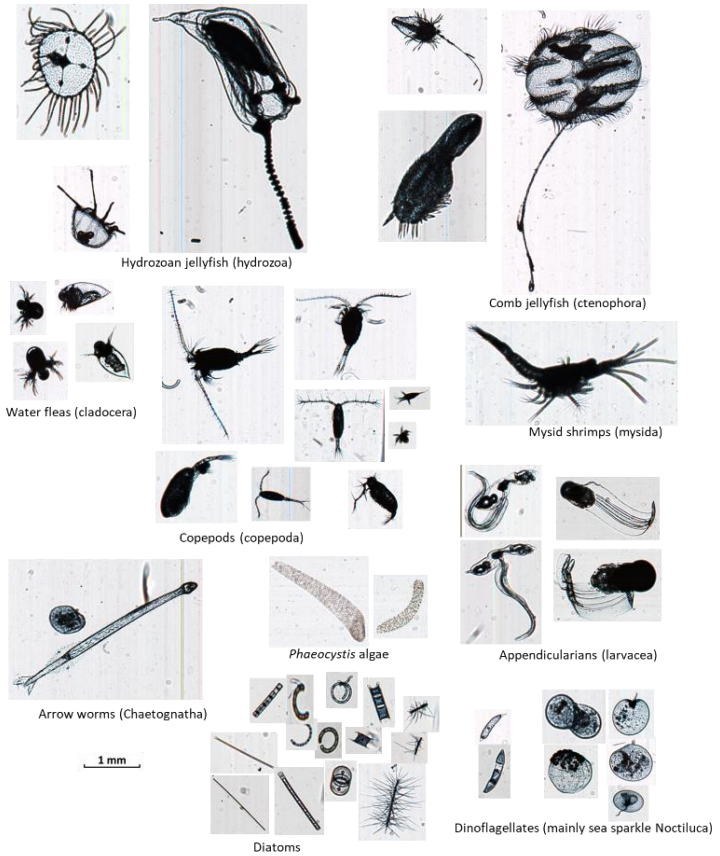
RV Zirfaea
(water quality)

RV Tridens
(fisheries)

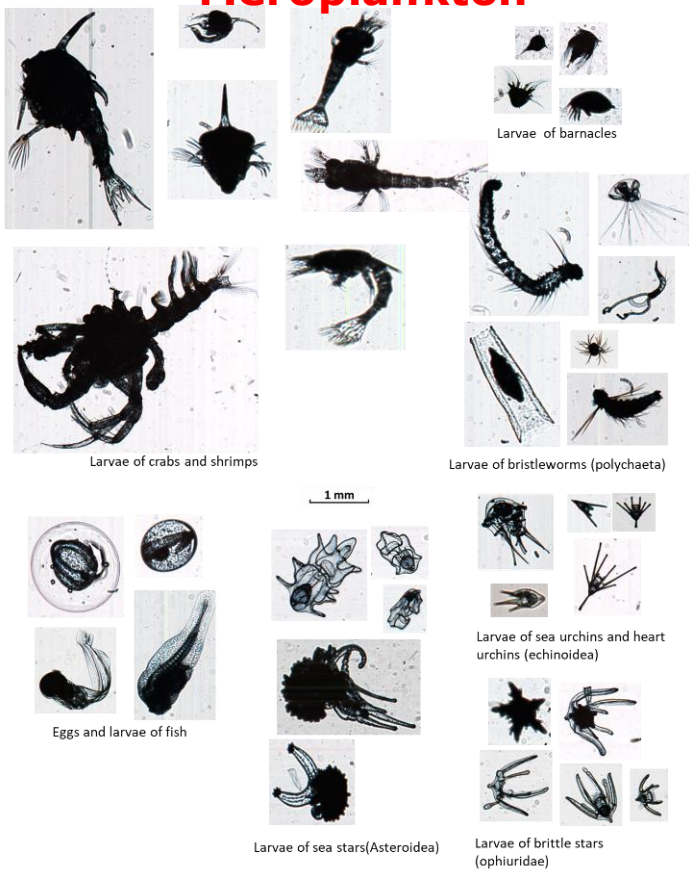


On-board imaging – Coastal North Sea

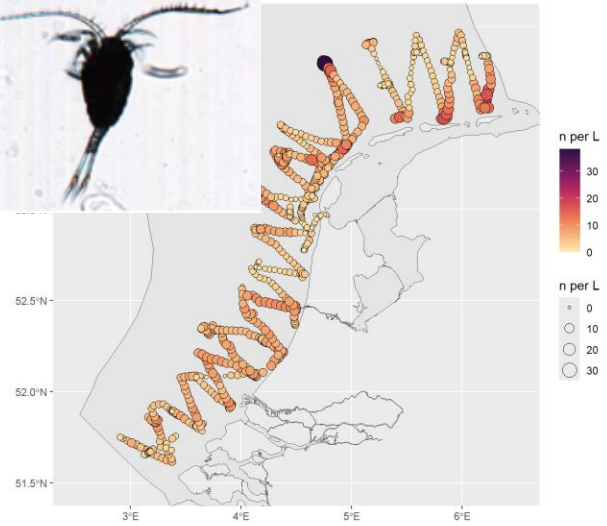
Holoplankton (incl. gelatinous)



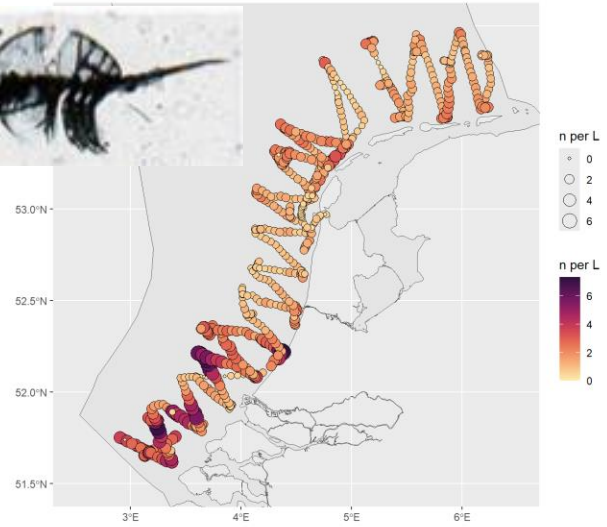
Meroplankton



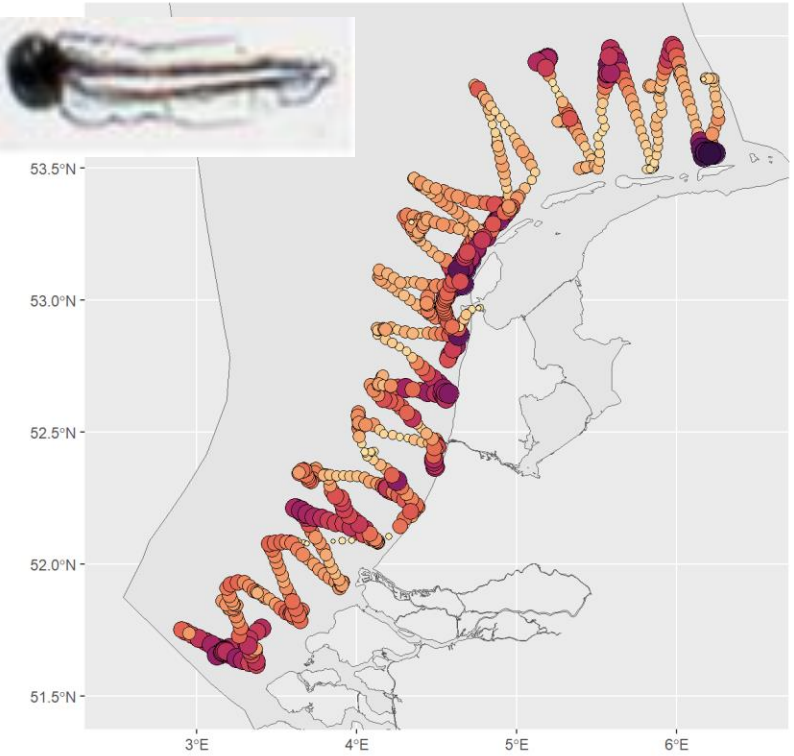
Copepods



Exuvia (empty skins)

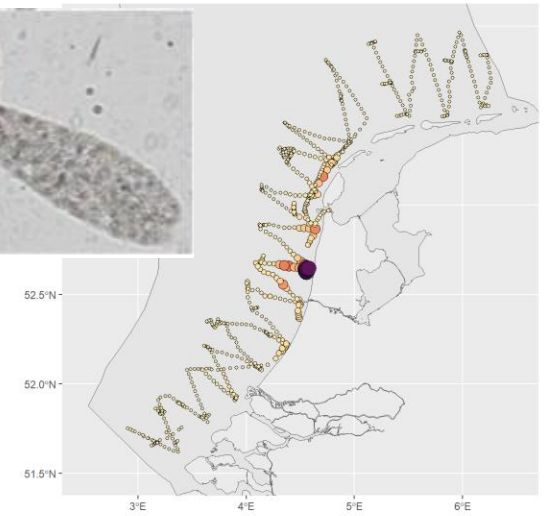


Oikopleura

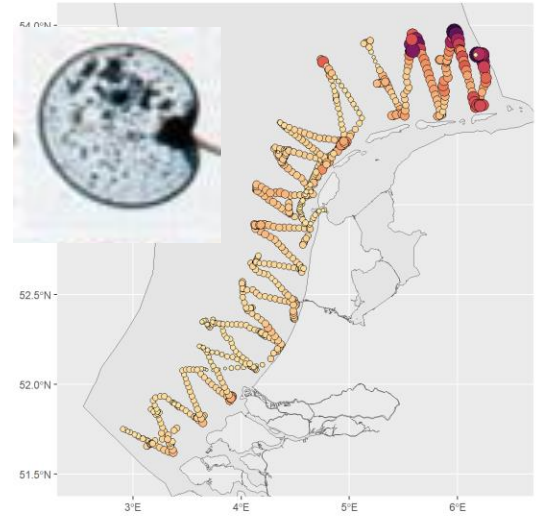


All Larvaceans: >40 ind L^{-1}

Phaeocystis



Noctiluca



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Mobile imaging – in development

REDstack:

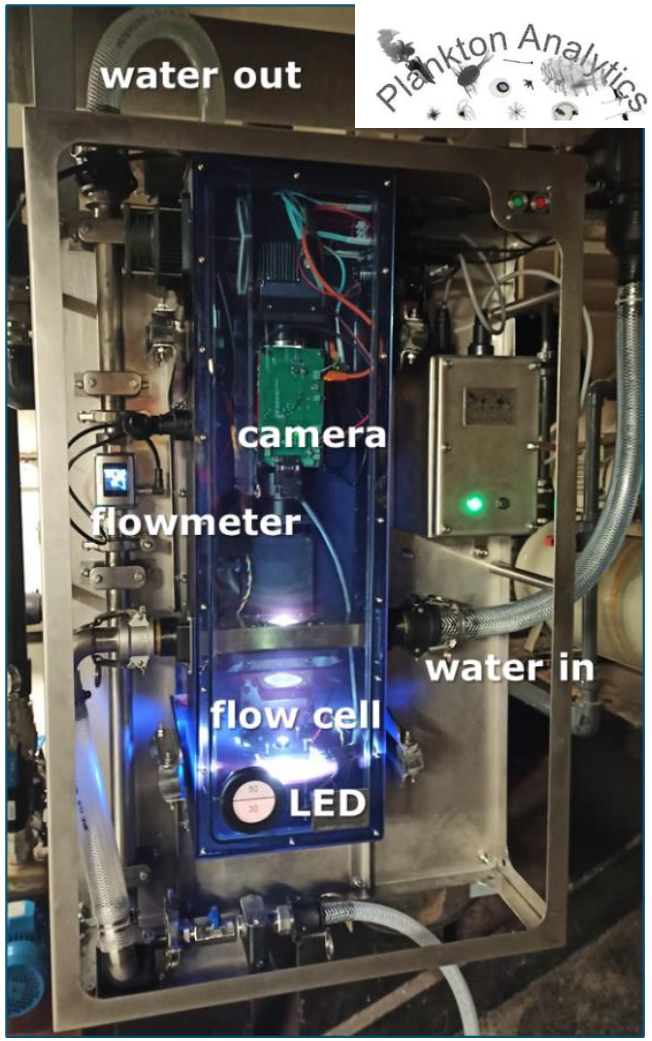
Company that develops membrane stacks to generate electricity by Reverse ElectroDialysis (RED)

For upscaling, large (up to 100m3/s) amounts of seawater are needed

Requirements:

- Mortality of plankton (i.e. copepods and (fish) larvae) needs to be reduced to avoid ecological impact

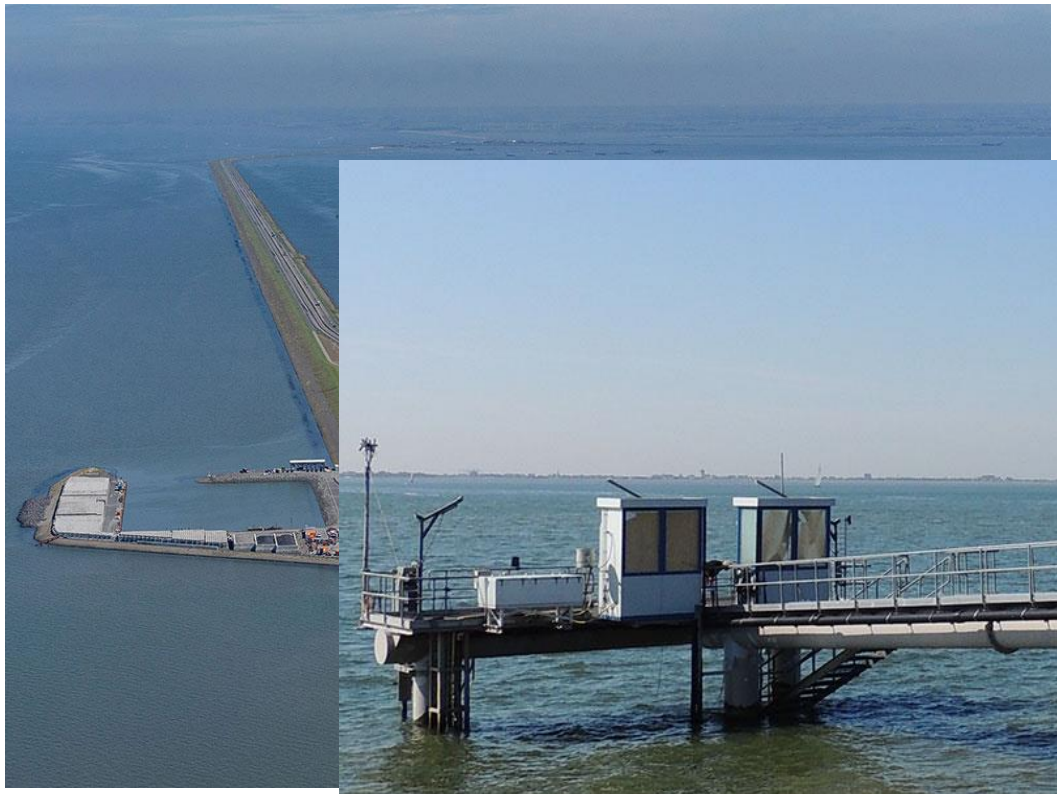
- Collection of water with fine particles (>10um) needs to be reduced to avoid pollution



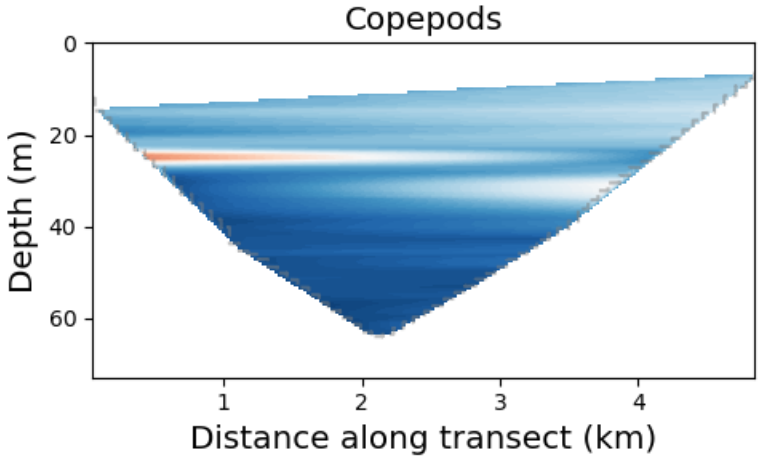
Development of a mobile container for mobile and real-time monitoring

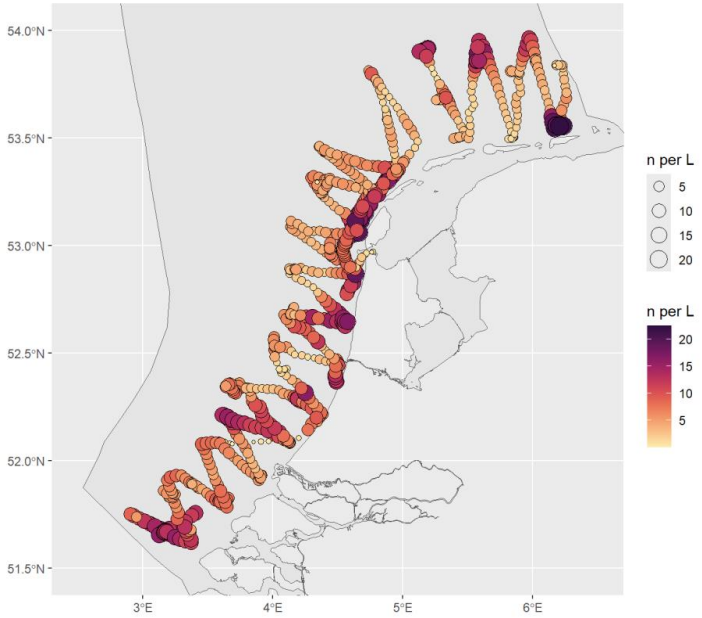
Check out the poster of Amin Niamir

Measurement of zooplankton and particles at facility and in Wadden sea



Summary


Copepods
Depth (m)
0
20
40
60
1
2
3
4
Distance along transect (km)


54.0°N
53.5°N
53.0°N
52.5°N
52.0°N
51.5°N
3°E
4°E
5°E
6°E
n per L
5
10
15
20
n per L
20
15
10
5