Addressing the effects of bottom trawling on benthic processes using **experimental** and field **studies** in the Baltic Sea

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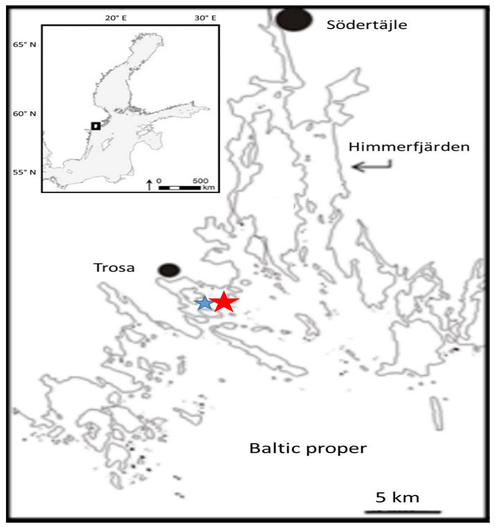
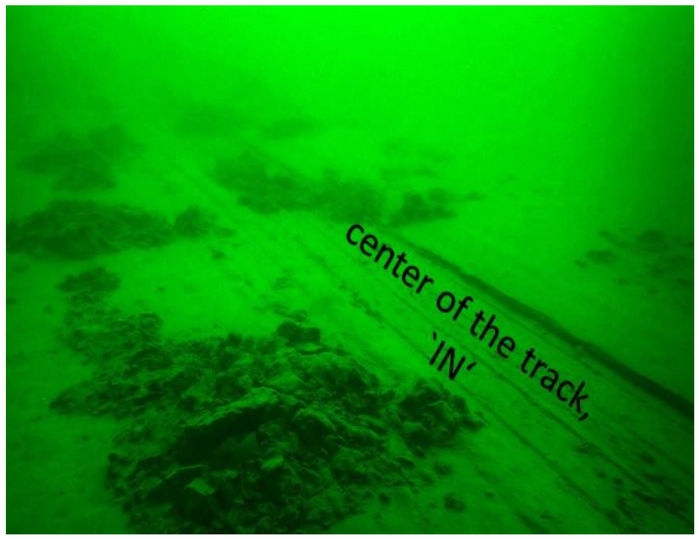


Study area: sheltered, soft-bottom habitat in the Himmerfjärden estuary. Experiment took place in October 2019.

Benthic dredge used to mimic scraping of surface sediment by a trawl door; 4 cm penetration depth.



Trawl track caused by the benthic dredge where ~2.5 cm surface sediment was removed.
Sediment cores taken by divers: in the center of the track (‚IN') and oustide (‚OUT') as controls.

Sediment cores:

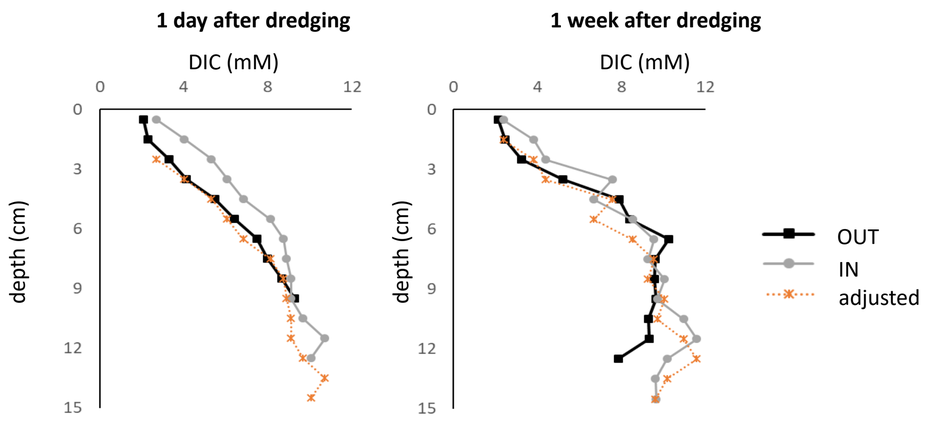
1) Benthic fluxes (O_2, NH_4^+, PO_4^{3-}, NO_x) directly, 1 week and 2 weeks after dredging (IN: n = 3, OUT: n = 5); macrofauna
2) DIC profiling (pore water)
3) Vertical chlorophyll profiling
4) Sediment properties (organic carbon, water content)

Diverse footprints

- ↓ chlorophyll, organic carbon: lowered food quality
- Removal of macrofauna: potential loss of highly valuable functions
- transient biogeochemical cycling, accompanied by gradual recovery (= diffusion towards overlying water) → new steady state

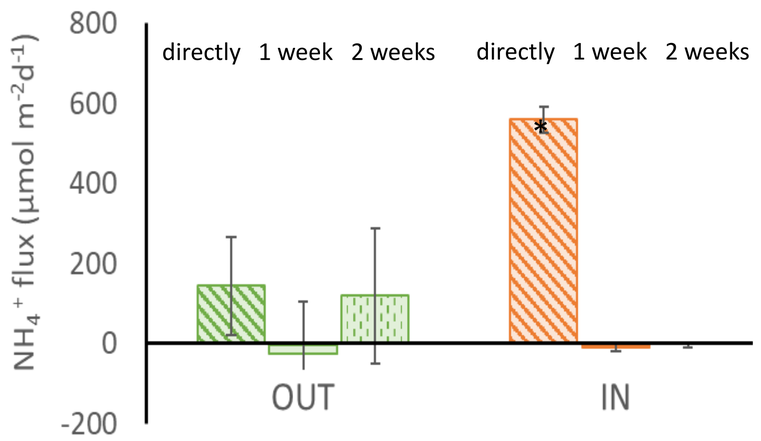
The remarkable footprint caused by a single dredge passage implies the even more drastic consequences for the Baltic Sea where trawling occurs up to 25 times per year in certain areas.

Pore water DIC



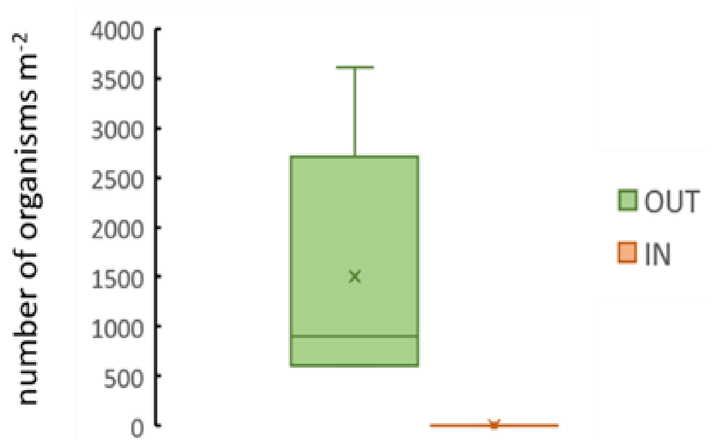
- Truncation effect inside the track due to removal of surface sediment visible by adjustment of IN-profiles (2.5 cm 1 day and 1.5 cm 1 week after dredging)
  → re-establishment of the sediment
- Similar for vertical chlorophyll profiles and sediment properties

Benthic fluxes



- Pulse release of NH_4^+ directly after dredging;
  → re-establishment of natural conditions after 1 week
- Significantly reduced O_2 uptake inside the track

Macrofauna



- No significant increased PO_4^{3-} and decreased NO_x- fluxes, however trend visible
- Removal of macrofauna

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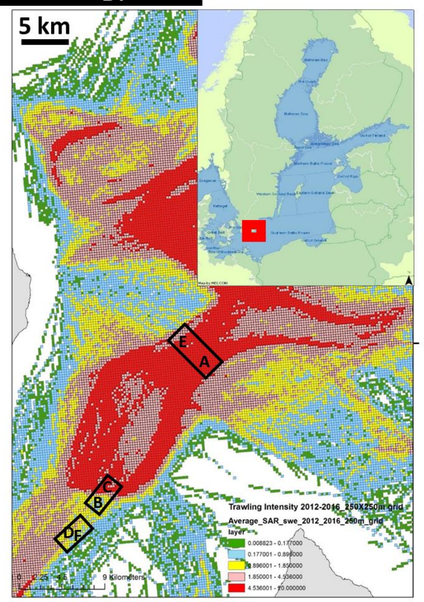
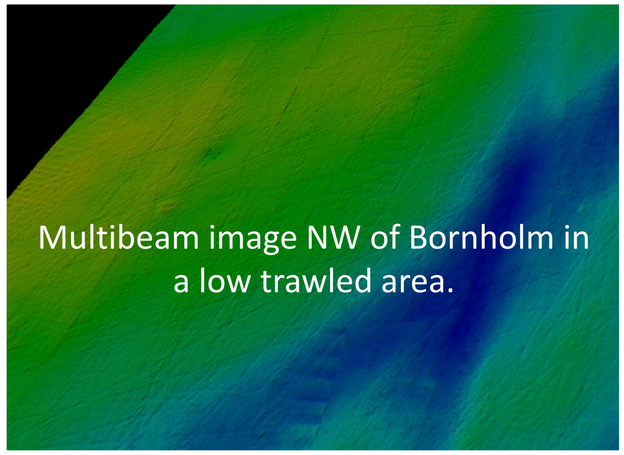


55°30′N

14°20′E

(Colour scale is average bottom trawling intensity 2012-2016)



Study area: 6 commercially fished areas in the Bornholm Basin (Baltic proper) of different fishing intensities: 3 low (green), 3 high (red).

Van Veen grabs:

1) Macrofauna community composition
2) Functional group composition

Sediment cores:

1) Benthic fluxes (O_2, NH_4^+, PO_4^{3-}, NO_x)
2) Depth distribution of macrofauna
3) Vertical chlorophyll profiling
4) Isotope profiling (^{234}Th, ^{210}Pb, ^{7}Be, ^{137}Cs)
5) Sediment properties (organic carbon, water content, porosity, grain size)

Multibeam, sub bottom profiling:

1) Seabed profiling
2) Quantification of physical disturbance

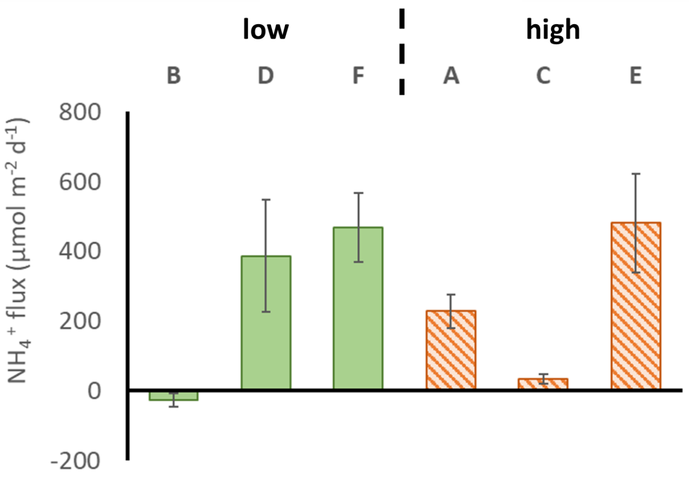
CTD:

1) Abiotic parameters (salinity, temperature, oxygen, turbidity)
2) Water samples (SPM)

Outlook: Upcoming cruise to the Bornholm Basin in May 2020: Relative importance of environmental variability and trawling will be assessed.

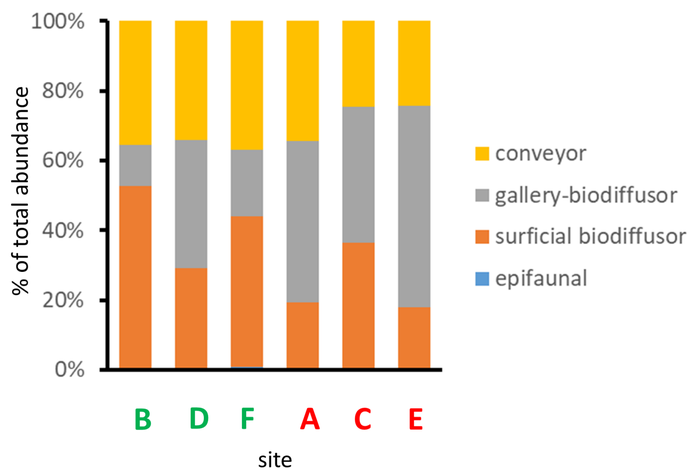
No strong effect of bottom trawling on the benthic habitat visible due to more pronounced site-specific characteristics. Effects may become visible when comparing closely located sites.

Benthic fluxes



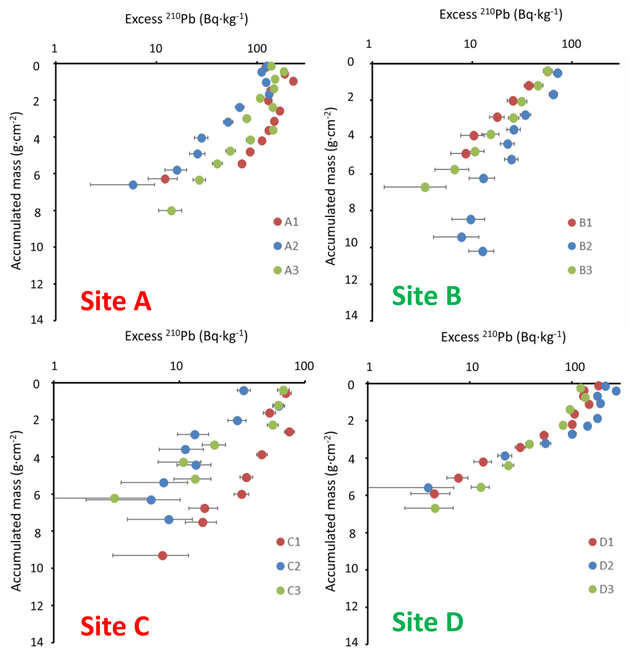
- No significant differences in benthic fluxes between low and highly trawled areas
- Similar for sediment properties and chlorophyll

Macrofauna: functional groups



- Reworking trait: higher proportion of gallery-biodiffusors at highly trawled sites
- Other traits: no clear differences
- Closely located sites B + C: clear differences in most traits

^{210}Pb: sediment mixing



High trawl intensity
- A: mixed layer of 4-8 cm
- C: horizon of excess ^{210}Pb not reached, likely due to mixing; mixing dominates the upper layers

Low trawl intensity
- B2: horizon of excess ^{210}Pb is not reached at 11 cm, likely due to mixing; B1+3: short profiles of excess ^{210}Pb → significant role of mixing?
- D: mixed layer in the upper few cm

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