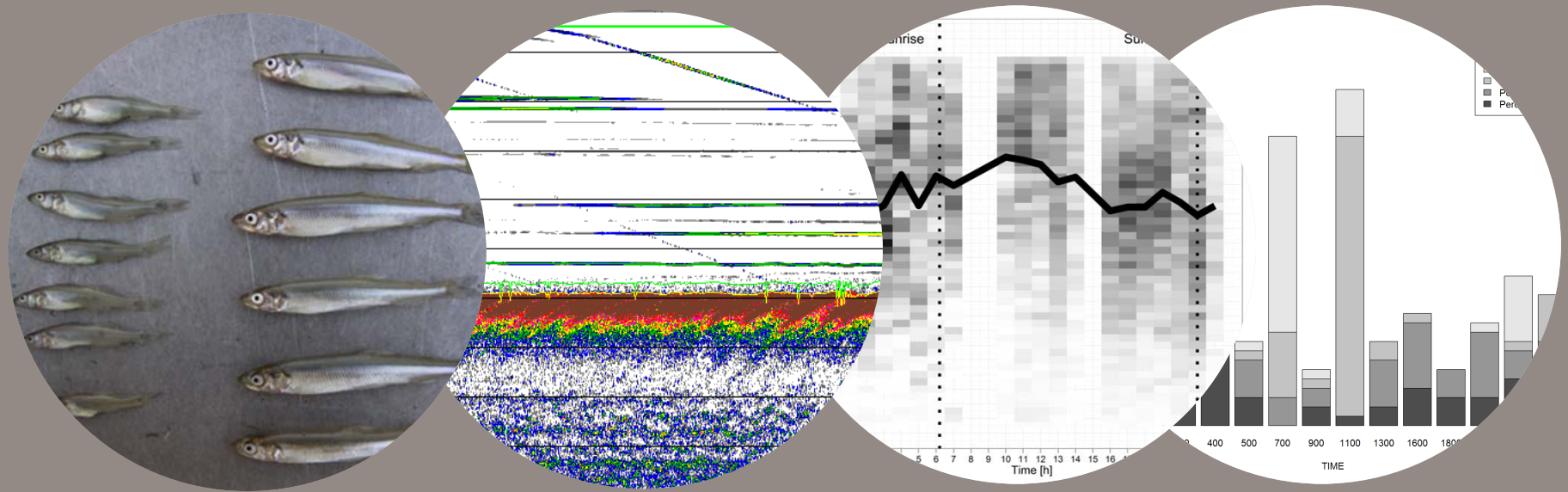
Target strength and behaviour of smelt

Sven Gastauer, Sascha Fässler, Bram Couperus, Marieke Keller

2013



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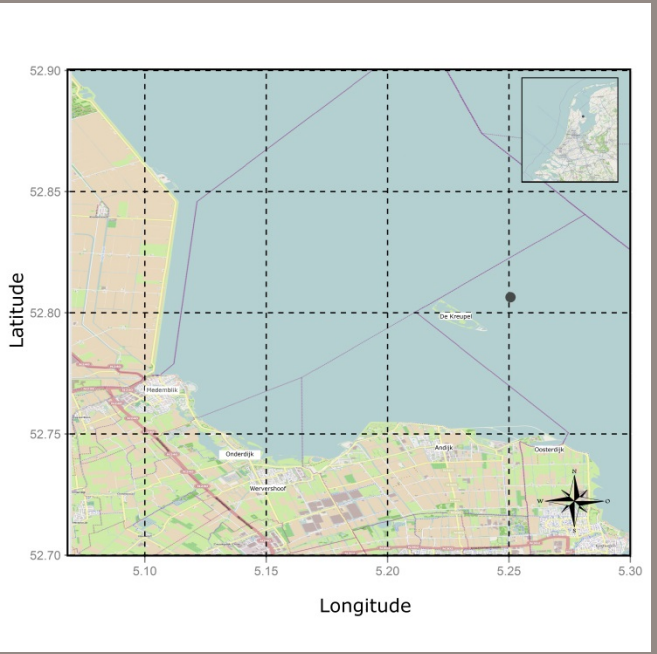
Study area & species

- Lake Ijsselmeer (largest lake of the Netherlands)
- Natura 2000 area (EU Birds and Habitat Directive)
- Very shallow (6m)



- Smelt (*Osmerus eperlanus*)
- Small fishery during 2-3 weeks
- Important prey species

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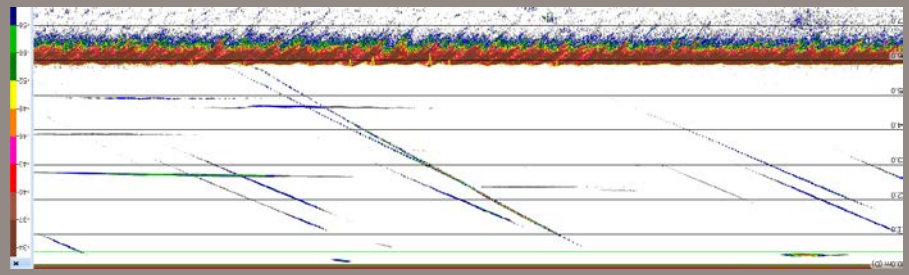
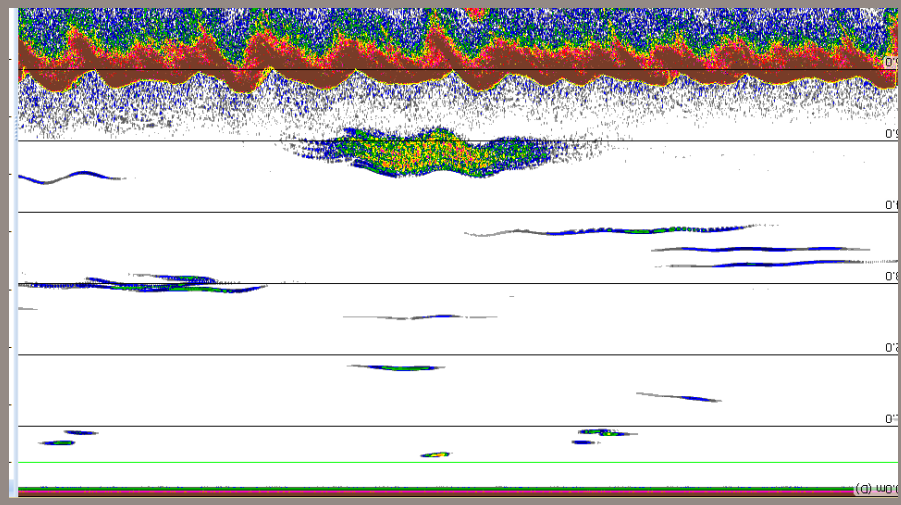
Acoustic data collection

- Previous studies looking at TS of rainbow smelt and European smelt
- Bottom mounted upward looking Simrad EK60 200 kHz echosounder
- Data recorded:

  15/08/2012 16:00-22:00

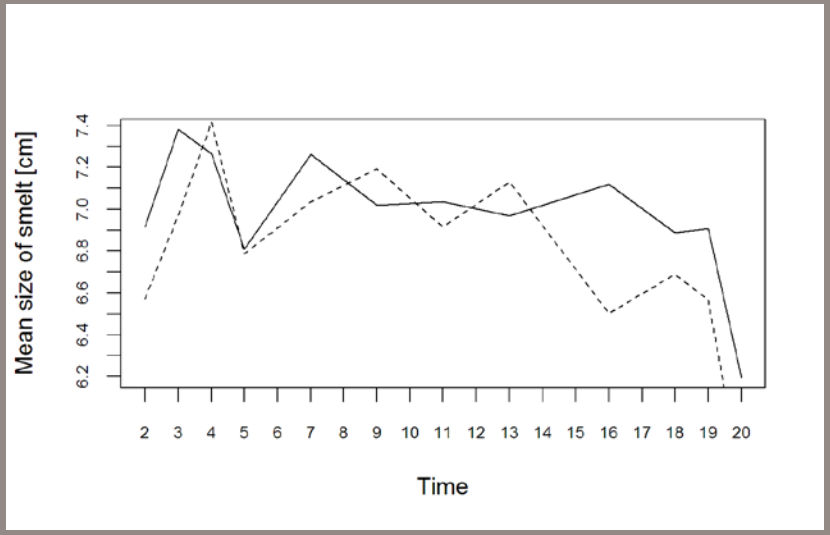
  16/08/2012 01:00-14:00



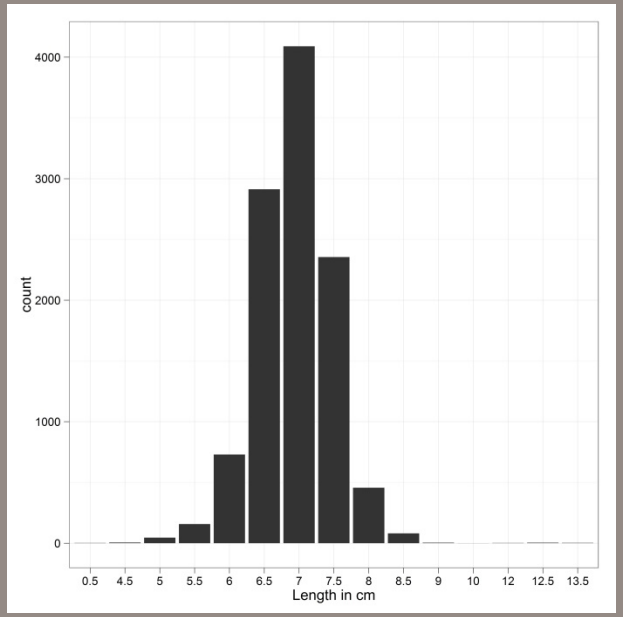


Biological sampling

- Modified beam trawl containing two nets
- Surface layer 0 - 1.5m
  Near bottom 4 - 5.5 m



- 14 trawls, 95.5 % smelt
- Mean length: 7 cm (4.4-13.7 cm)



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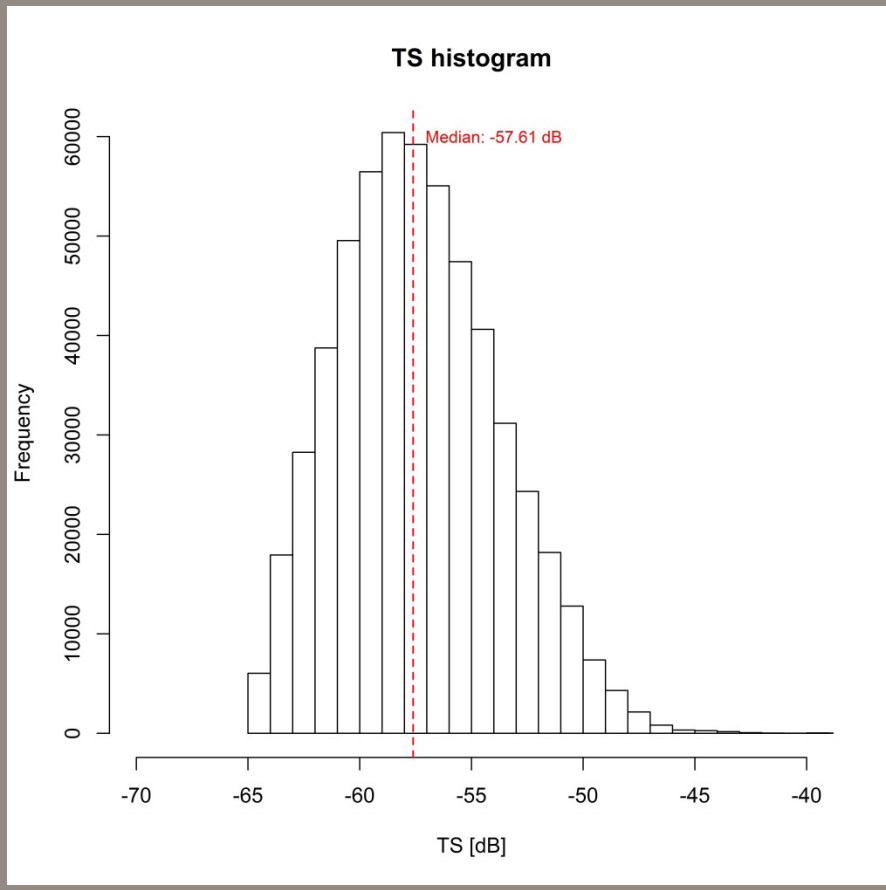
Target strength 1/2

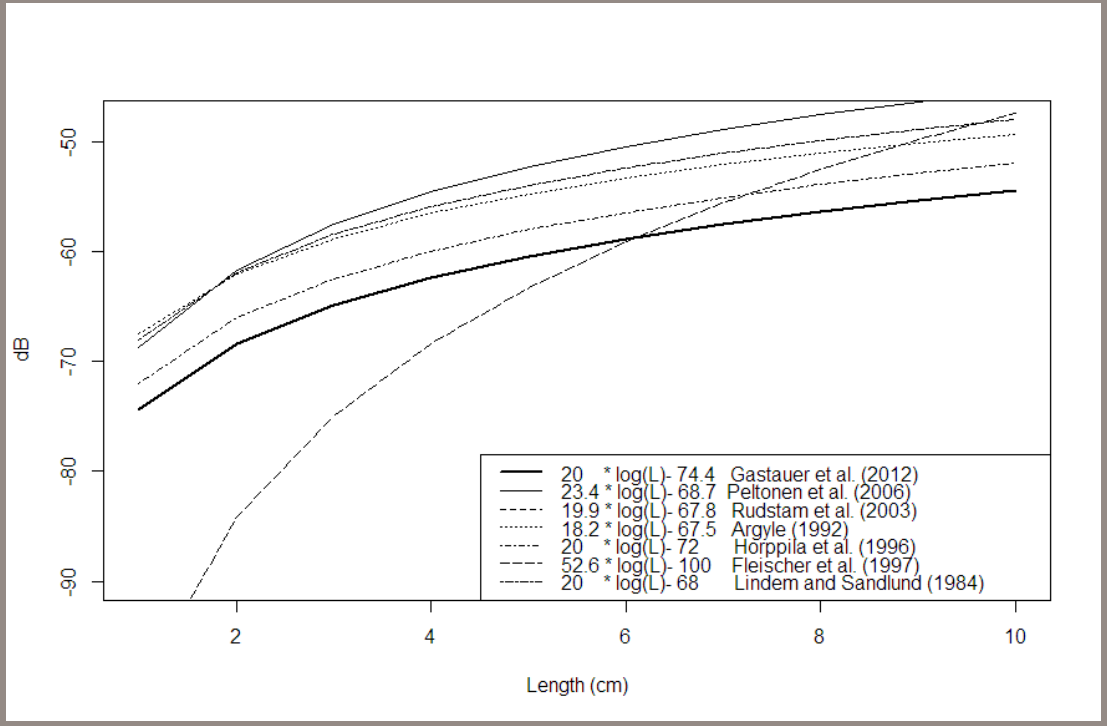
- Threshold: -65 dB (Peltonen, 2006)
- Schools excluded
- Range: 0.5 – 5.5 m
- Mean of all single targets
- Median: -57.61 dB



Target strength 2/2

$$TS_{smelt} = 20 \log (L) - 74.4$$

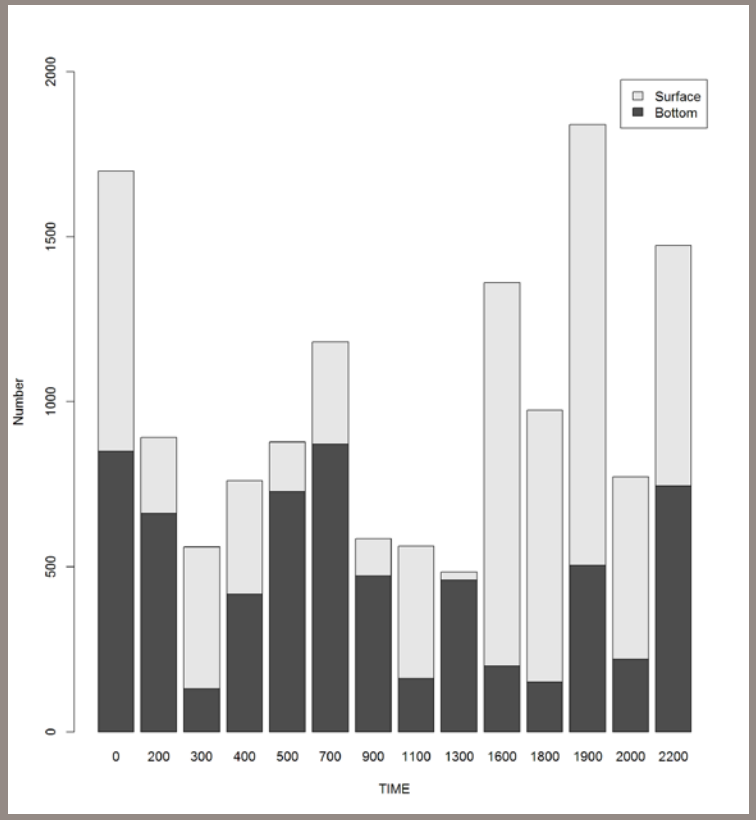
- Target strength lower than previous studies
  - Ventral measurement
  - different frequency
  - different hydrography



Vertical migration - Catch information

- 15% more fish caught close to the surface
- Negative correlation for smelt caught close to the surface and bottom

Correlation: R = -0.51, df = 10, p =0.09



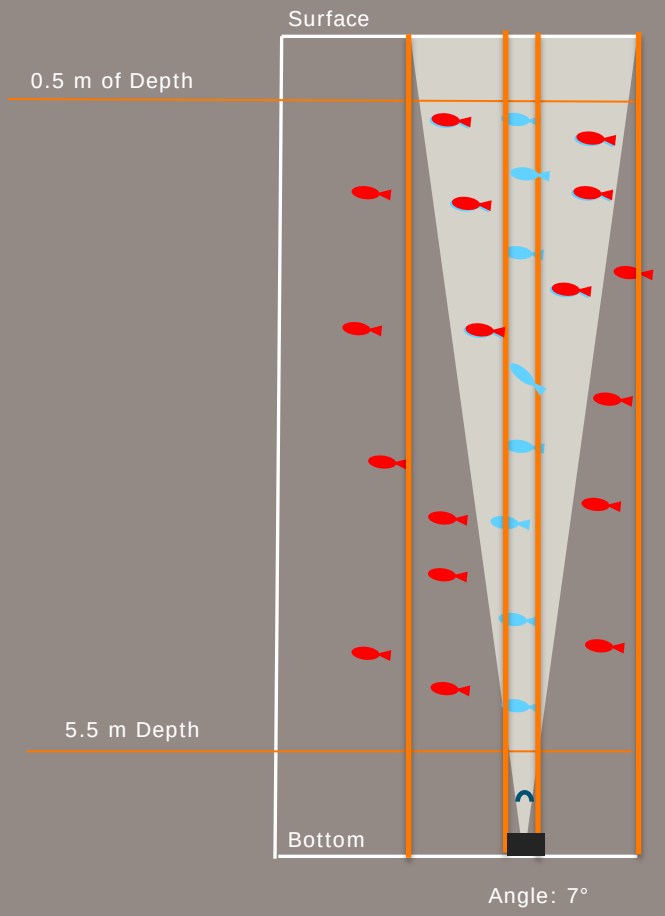
Beam compensation

- Beam angle = 7°
- r=dist. from transducer * sin (beam angle / 2)

- Circumference = 2 π * r

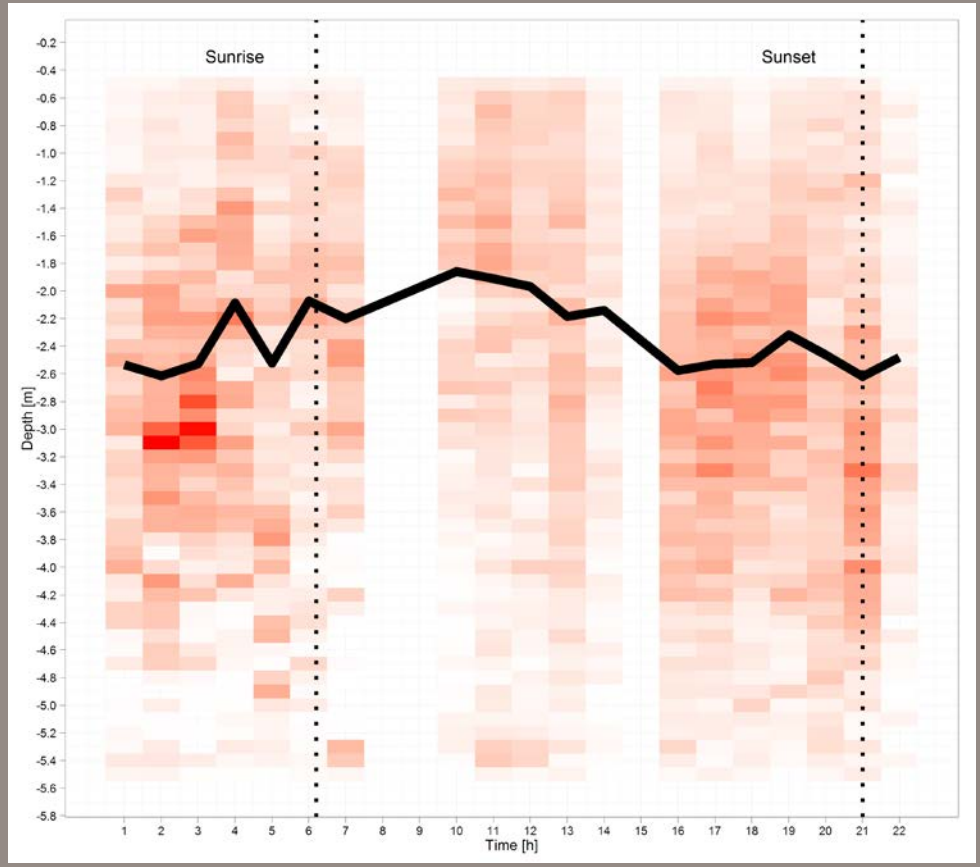
- Beam circumference:
  - 5.5m of depth = 0.19 m
  - 0.5m of depth = 2.11 m

  => Factor 11



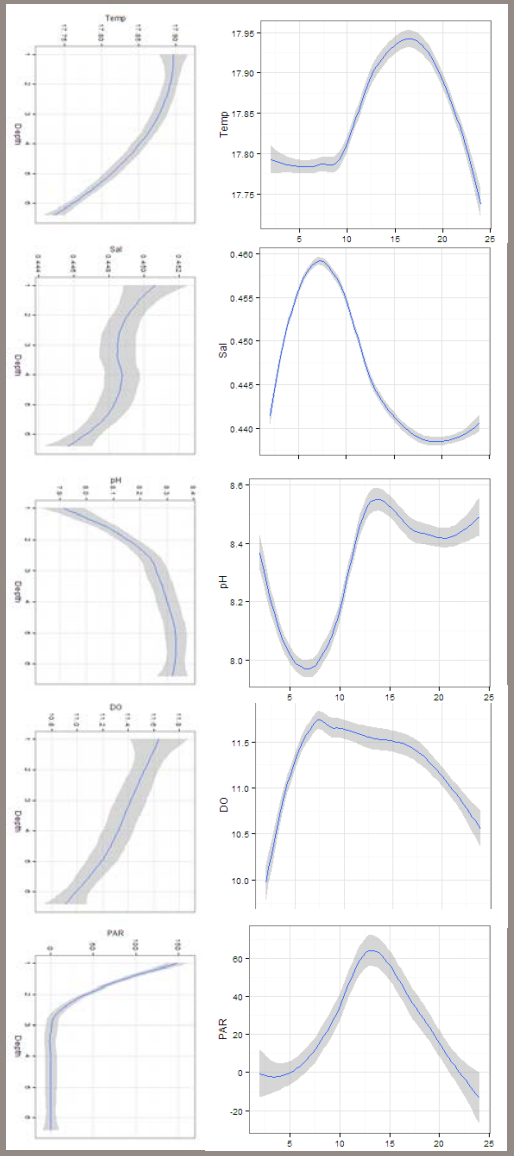
Vertical migration - acoustics

- Most of the smelt in the upper the water column
  median = 2.2 m (0.5-3m, 76.61 %)
- Before sunrise & after sunset: Dispersed
- Sunrise-solar noon: More clustered (0.5 - 2m)
- Solar noon – sunset: Clustered (1.8-3m)



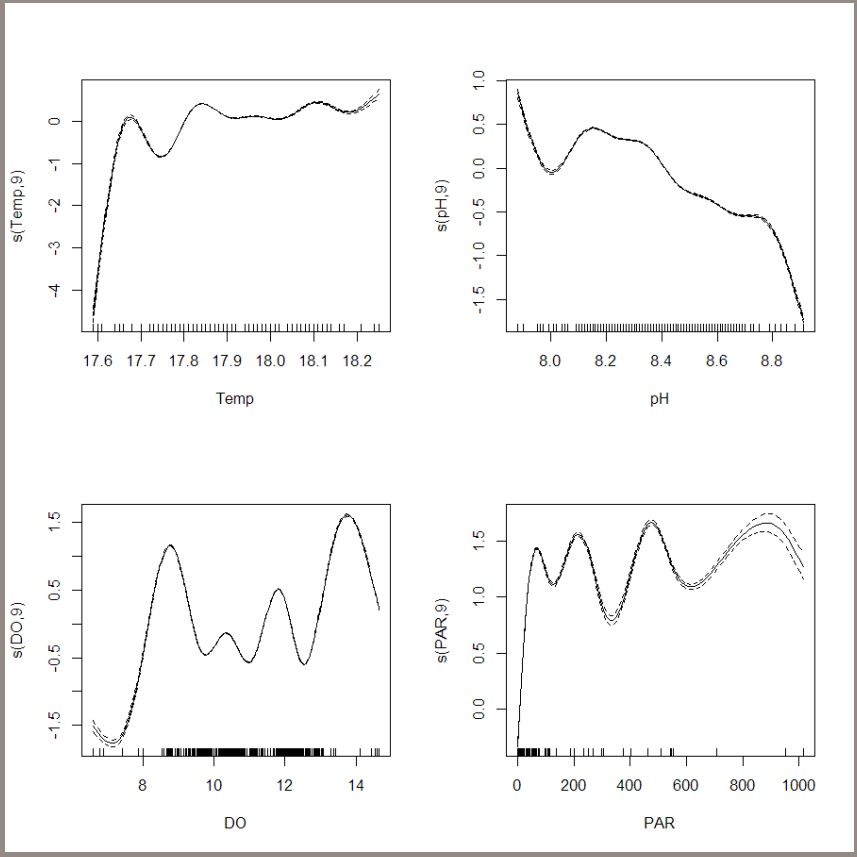
Hydrographical data collection

- Temperature — 17.59 – 18.30 °C (mean 17.83°C)
- Salinity — 0 .38 – 0.46 ppt (mean 0.45 ppt)
- pH — 7.8 - 8.7
- Dissolved Oxygen — 5.62 – 14.63 mg/L (mean 11.28 mg/L)
- Photosynthetically active radiation — 0-1015 µE/s/m²



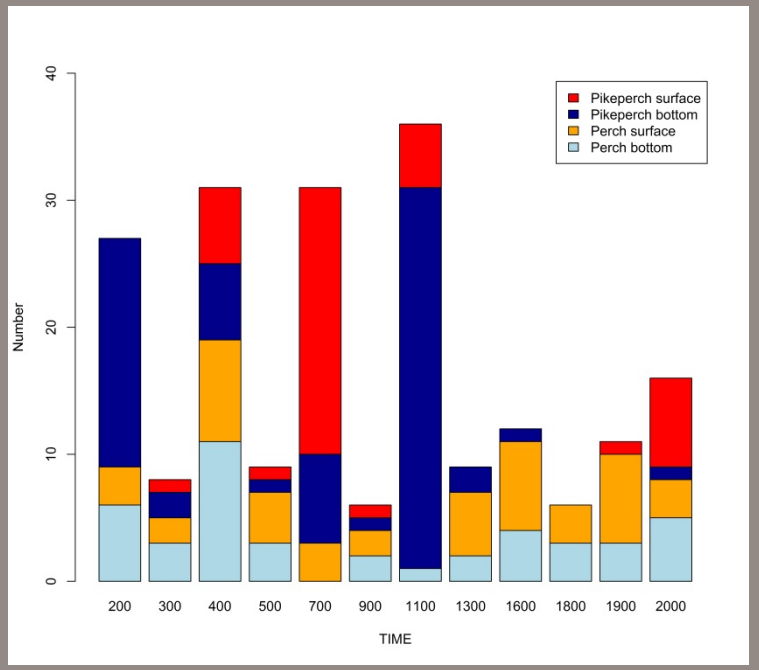
Environmental driving factors

- GAM analysis detected pH, temperature, DO and PAR ($p<0.01$) as significant
- Regularly spread over the entire temperature range
- Most abundant in areas with DO 9 -13 mg/l
- Most abundant at PAR 0- 200 µE/s/m²



Prey – predator interactions

- Smelt close to the bottom pos. cor. with pike-perch close to the bottom (R = 0.52, df =11, p=0.07)
- Smelt close to the surface pos. cor. with pike-perch close to the surface (R = 0.38, df = 11, p=0.20)
- Nsmelt neg. cor. with smelt caught close to the bottom (R = -0.51, df = 10, p =0.09)
- Depth of acoustic smelt detections neg. cor. with pike-perch close to the bottom (R = -0.50, df = 8, p=0.14) and close to surface (R =-0.46, df = 9, p=0.16)



Conclusions

- Smelt is found throughout the entire water column, more dispersed before sunrise
- Smelt close to surface with high light intensity -> turbid water
- DO not extreme values (>5mg/l = optimum (Horppila et al. 2000))
- Main concentrations at pH>8 but no avoidance pattern
- No clear avoidance for temperature (Critical temperature > 20° in lake Peipsi, Kangur (2005))
- Salinity variations too small
- Smelt observed to swim upwards and numbers decrease if pike-perch was caught
- Only 2 schools observed

=> Migration more likely to be linked to predator avoidance as reported by Mous (2000) contradicting Piersma et al (1998) reporting schooling behaviour

Thank you

Any questions?