Changes in macrobenthos: past versus present

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New European legislation: what is a “Good Ecosystem State”? GES

- Since the 1990s, various european Directives aimed at nature protection have been issued. The most recent is the « Marine Strategy » Framework Directive – « MSFD »

- The MSFD targets reaching a GES in European seas. Targets are defined for 11 different descriptors of the marine ecosystem, including « seafloor integrity ».

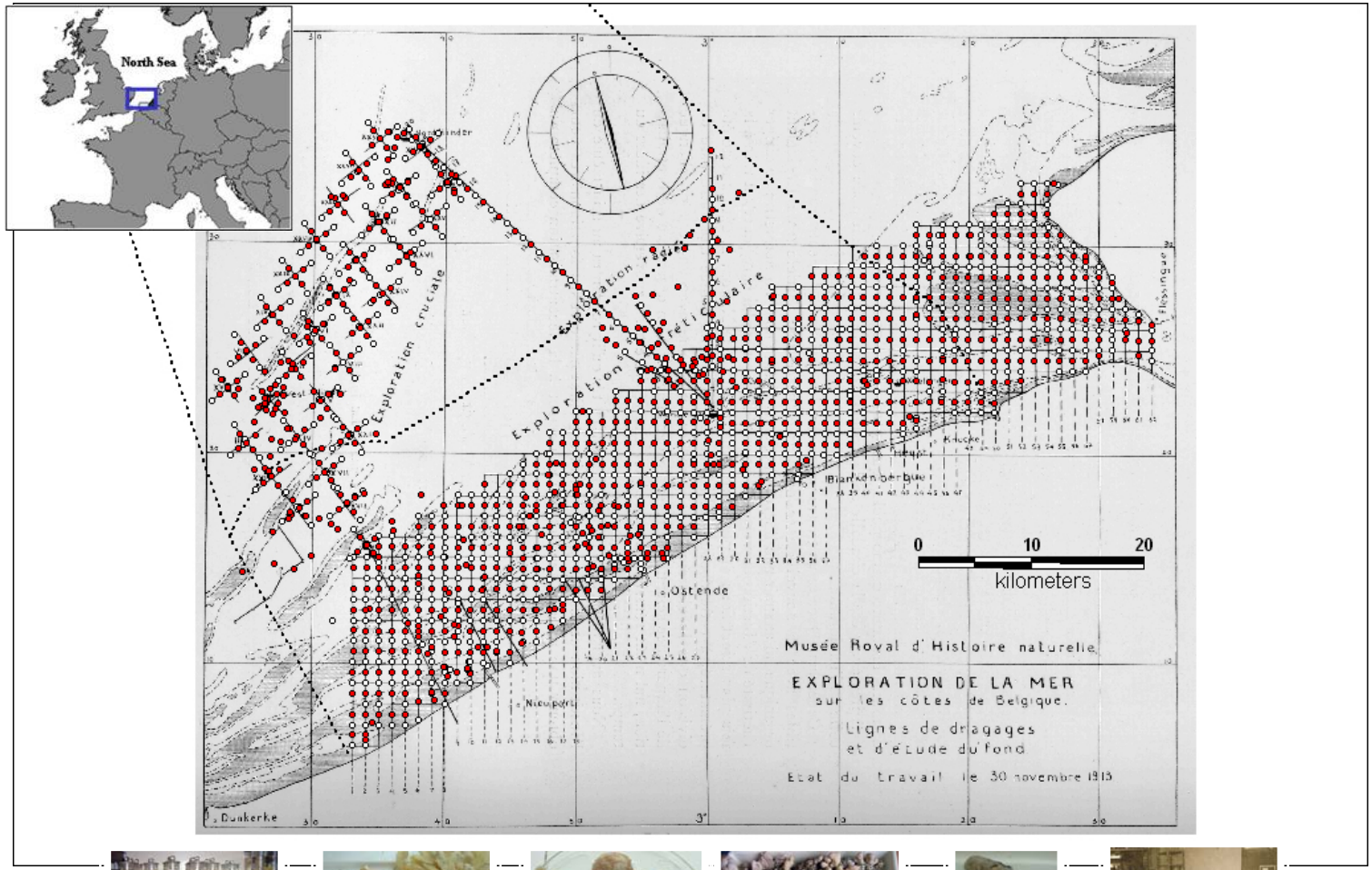
  - “Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.”

- This directive and others involves the definition of objective criteria towards measurement of the GES

- The measurement of the amplitude of change induced by human pressures is necessary to set meaningful targets => Baseline assessment

=> Benthos composition = sensitive indicator for change in the seafloor condition => Monitoring

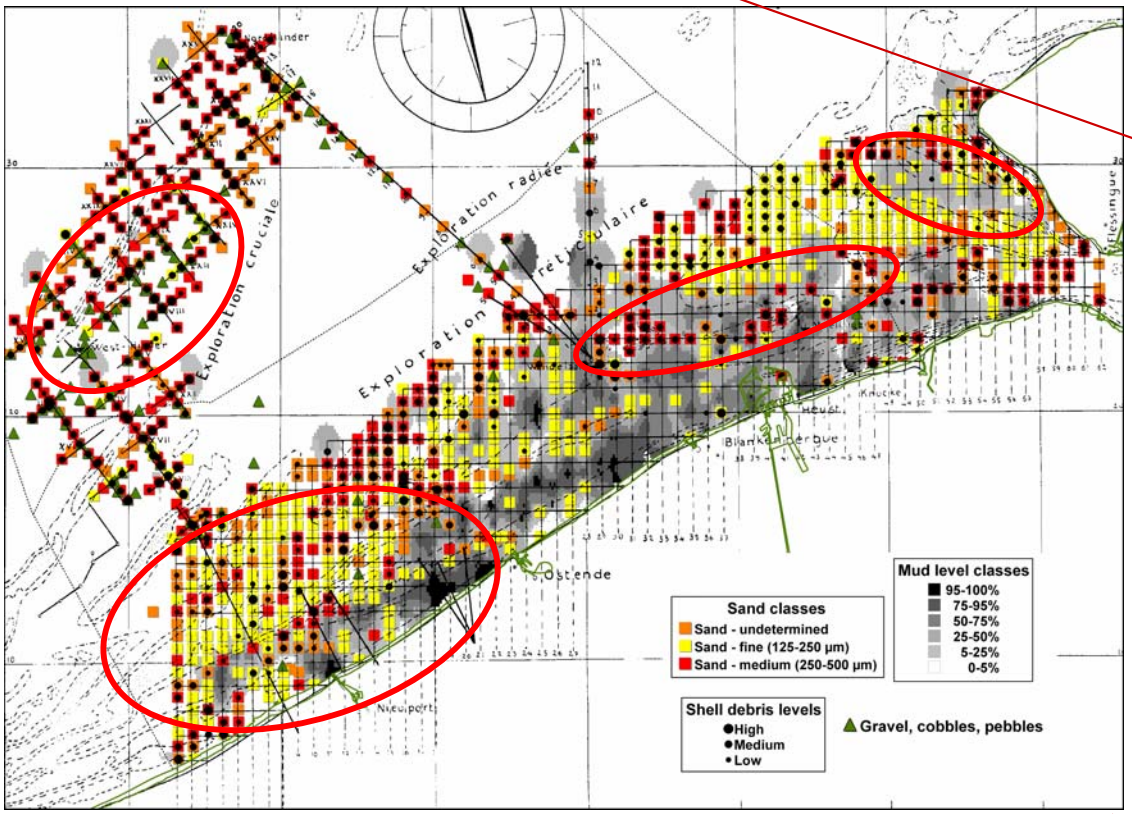
Belgium: a unique historical macrobenthic data set: The surveys and material of G. Gilson, 1899-1908

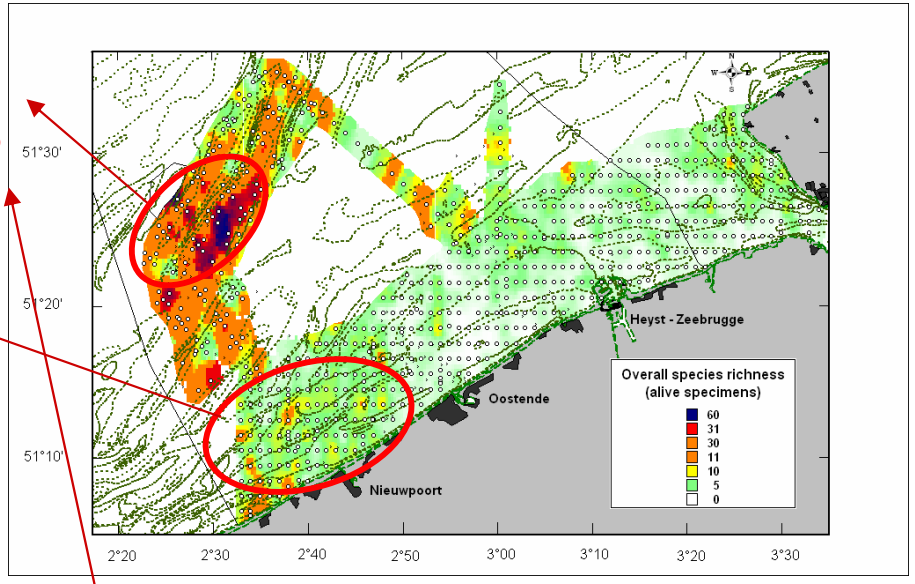


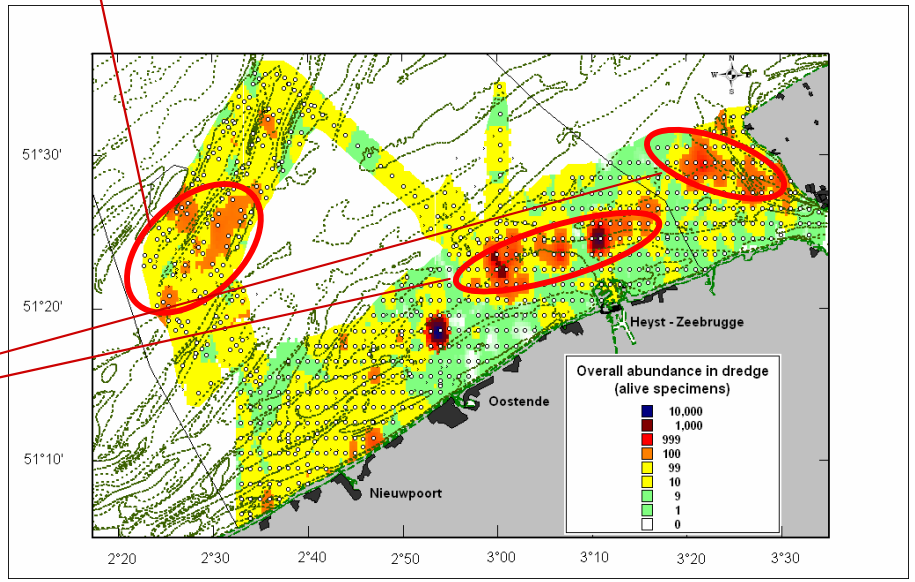
Seafloor and benthos, 1900: highlights

Western coast: moderate diversity and density (in- and epifauna)

Epibenthic community of open-sea gravels: large taxonomic diversity and densities







Highest densities (infauna), low species diversity

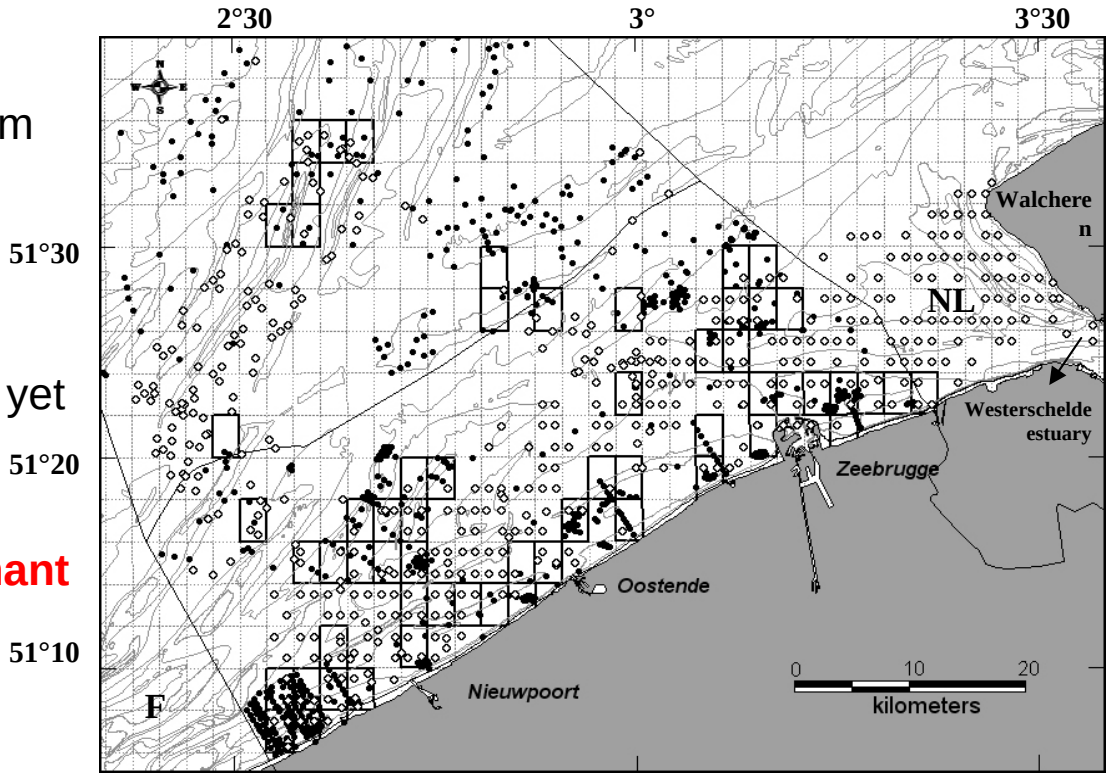
Coastal waters: case of dominant bivalves

- **Long-term analysis challenges for coastal macrobenthos:**

  Gilson's dredge data ⇔ Recent Van Veen data, 1994-2008 (joint DB of U. Gent + ILVO-Fisheries)

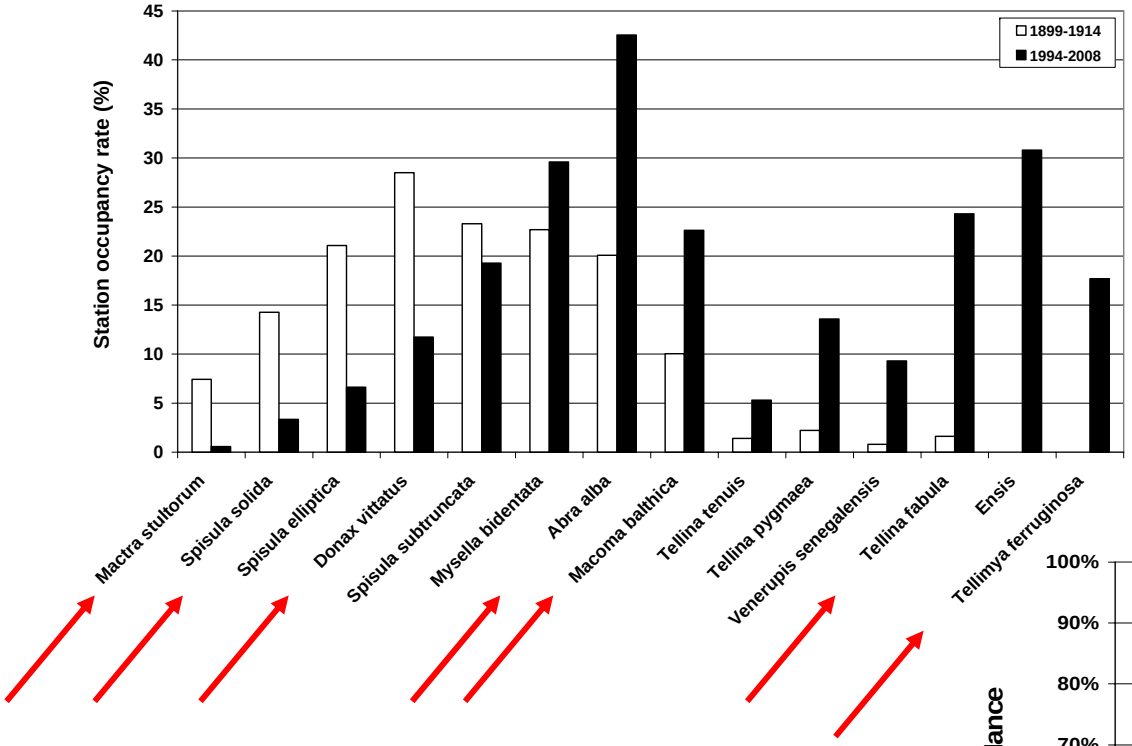
  ⇒ Sampling gear incompatibility:
  Point sampling ⇔ towed dredge (1,9 km long)
  Different efficiencies
  ⇒ Different spatial distributions
  ⇒ Historic data on soft-bottom macrobenthos: polychaetes not robust yet

- **Solutions:**
  - Spatial analysis of **numerically dominant bivalves** through data gridding
  - Standardize abundances to maximum values => distribution of ***relative densities***
  - P/A data => **difference maps**

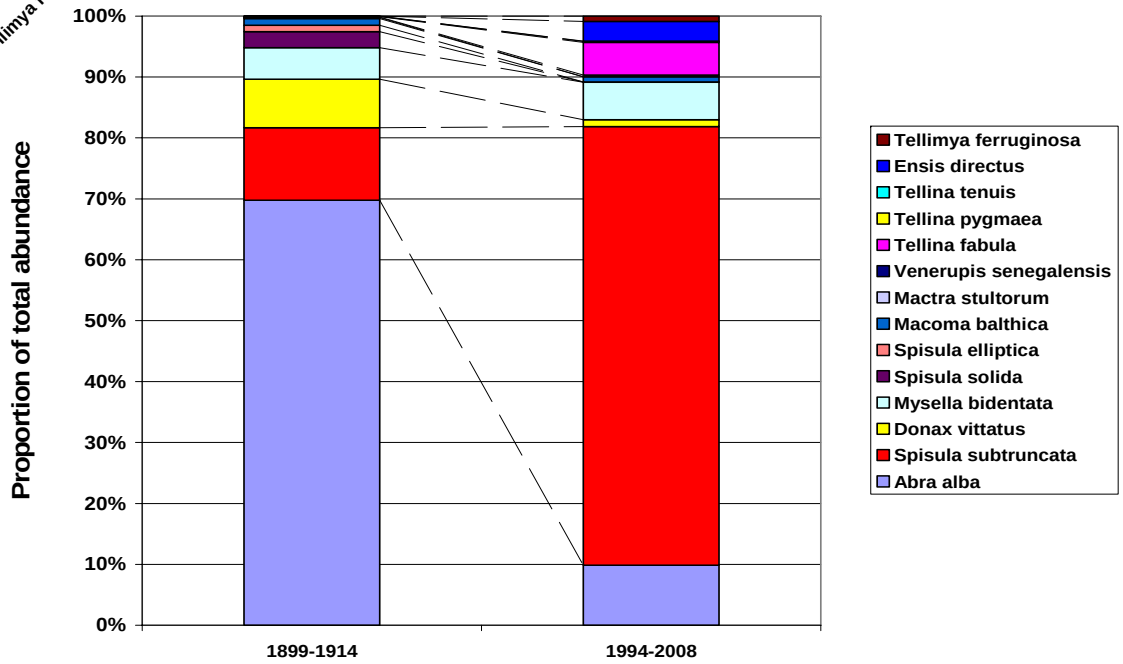


Coastal waters: case of dominant bivalves
General figures

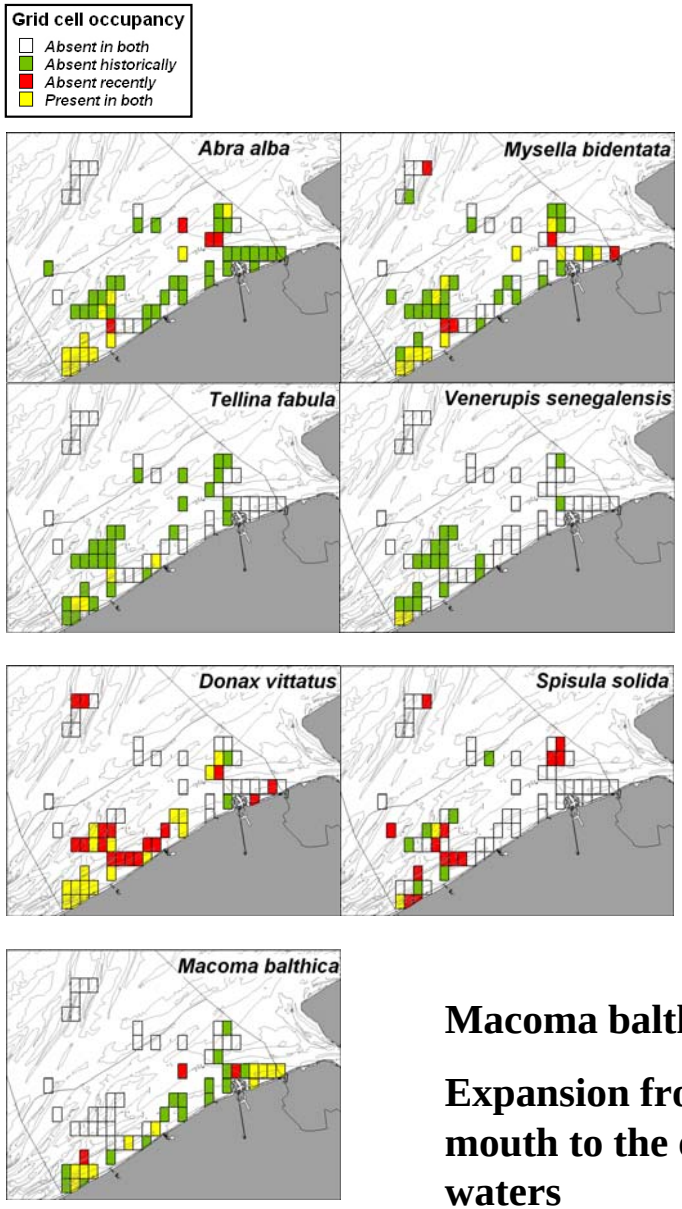
Station occupancy rates



Contribution to total abundance



Coastal waters: case of dominant bivalves
Geographic spreading



Muddy fine sand species:

Expansion

(+ shifts in relative density distribution)

Shallow clean fine sand, filter-feeding species:

Regression

Macoma balthica (estuarine):

Expansion from Schelde mouth to the entire coastal waters

⇒ **Probable impact of change in fine sediment dynamics (increased turbidity?)**

⇒ **Probable effect of eutrophication / pollution: increased benthic biomass/productivity?**

BUT:

- **Hydro-climatic factors (unlikely)**
- **Ensis directus invasion (unlikely)**
- **Other factors (fishery effects)?…**

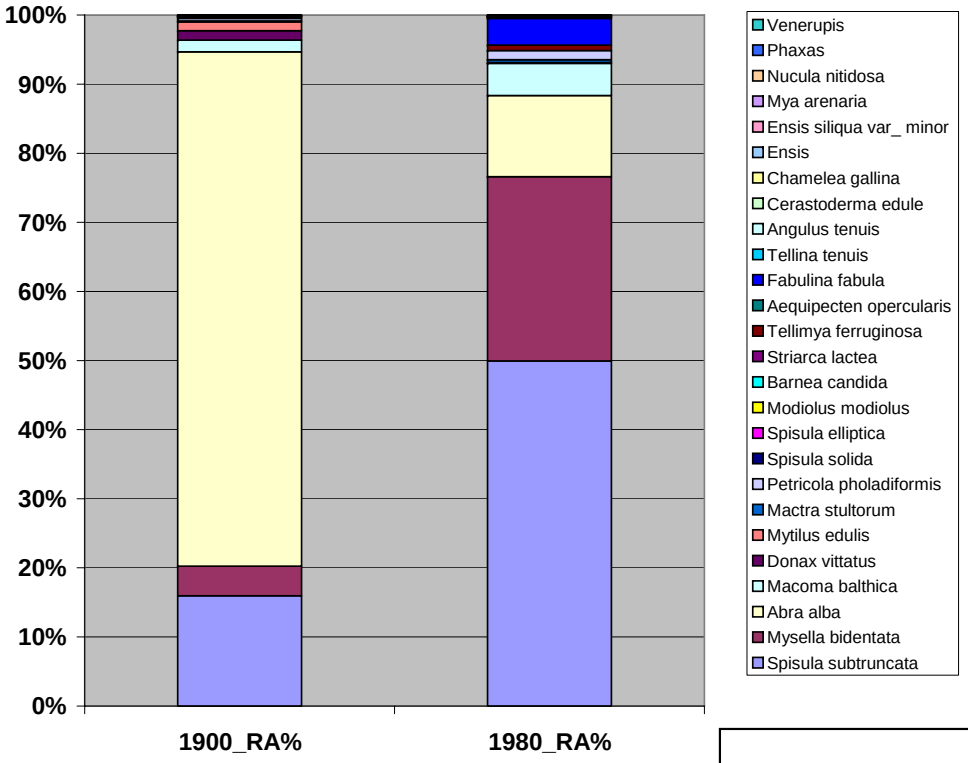
Change 1900 – 1970 > Change 1970-2000s

=> More 'sophisticated' biodiversity analyses once polychaete data checked

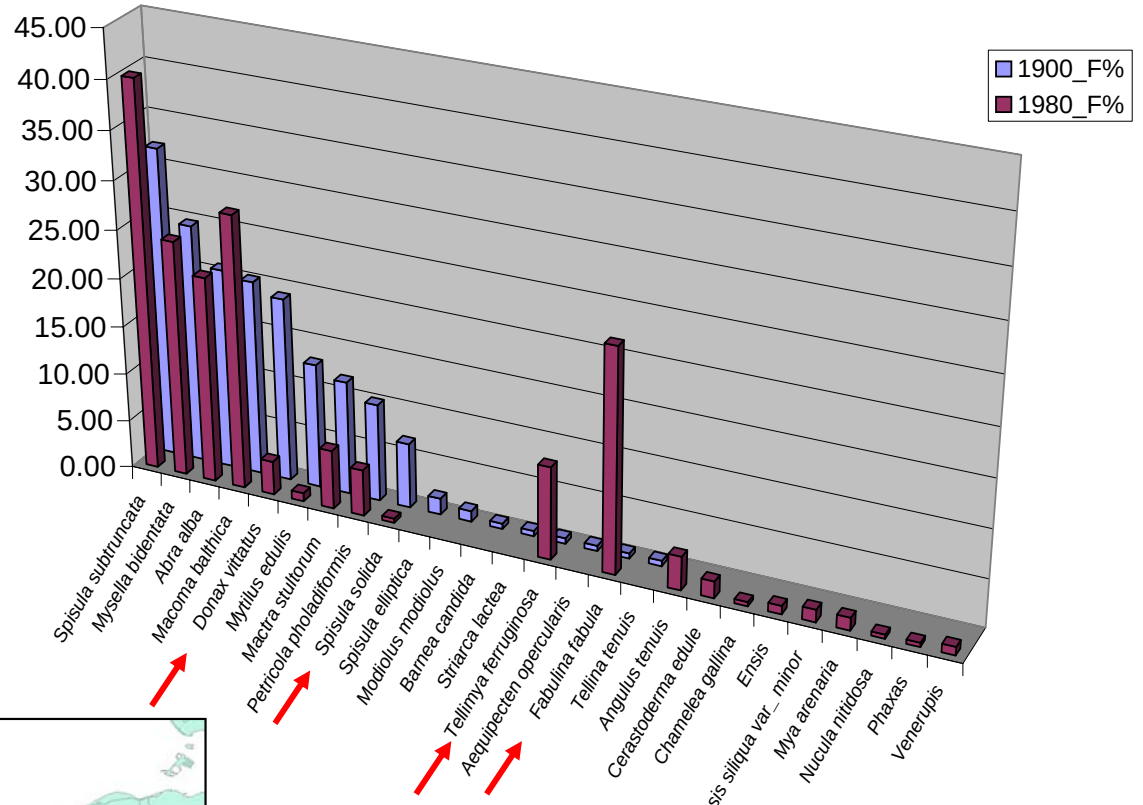
=> Incorporation of recent data from Dutch waters

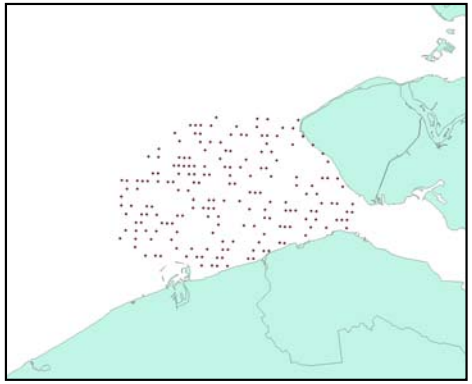
Westerschelde mouth : 1900 versus 1980-82 (J. Craeymeersch, IMARES)

Contribution to total density (14 species)



Station occupancy (% stations - spreading)





Present-day observation

- Ecosystem engineering – Rabaut and coll.
  - Lanice conchilega (tube building segmented worm)
    - Essential structuring component of the “Abra alba” macrobenthic community
  - Owenia fusiformis (tube building segmented worm)
    - Sand bank stabilisation. Recently thriving
- And in the 1900s and 1970s? => Gilson data and literature

Coastal 'ecosystem engineers' in the past

L. conchilega

- 1900: occasional - widespread
- 1970: occasional
- 1980s: common, max densities 2000/m²
- 1990s-2000s: essential component of A. alba community – very large densities (max 10,000/m² => "reefs")
- (NB. Typical component of sandy gravel associated fauna too)

O. fusiformis

- 1900: occasional, offshore
- 1970: occasional, offshore
- 1980s: occasional, low densities
- Mid-2000s: strong expansion in muddy fine sands with locally very large densities (max 11,000/m² => "reefs")

=> Recent thriving

Conclusions

- Macrobenthic communities of coastal waters since the 1970s are altered compared to the early 1900s, with different species thriving from the local pool.
- Increased influence of background turbidity (i.e. increased chronic deposition of mud)?
- Relatively more species contribute substantially to bivalve biomass: suggestion of biomass increase?

- Findings are consistent with moderate levels of organic enrichment in highly mixed coastal waters (eutrophisation effect)

- “Ecosystem engineer” tube-building worms: fate in the long run, link with ecosystem disturbance?

Thank you for your attention !