Long-term dynamics of soft-bottom subtidal community in a small inlet (the White Sea)

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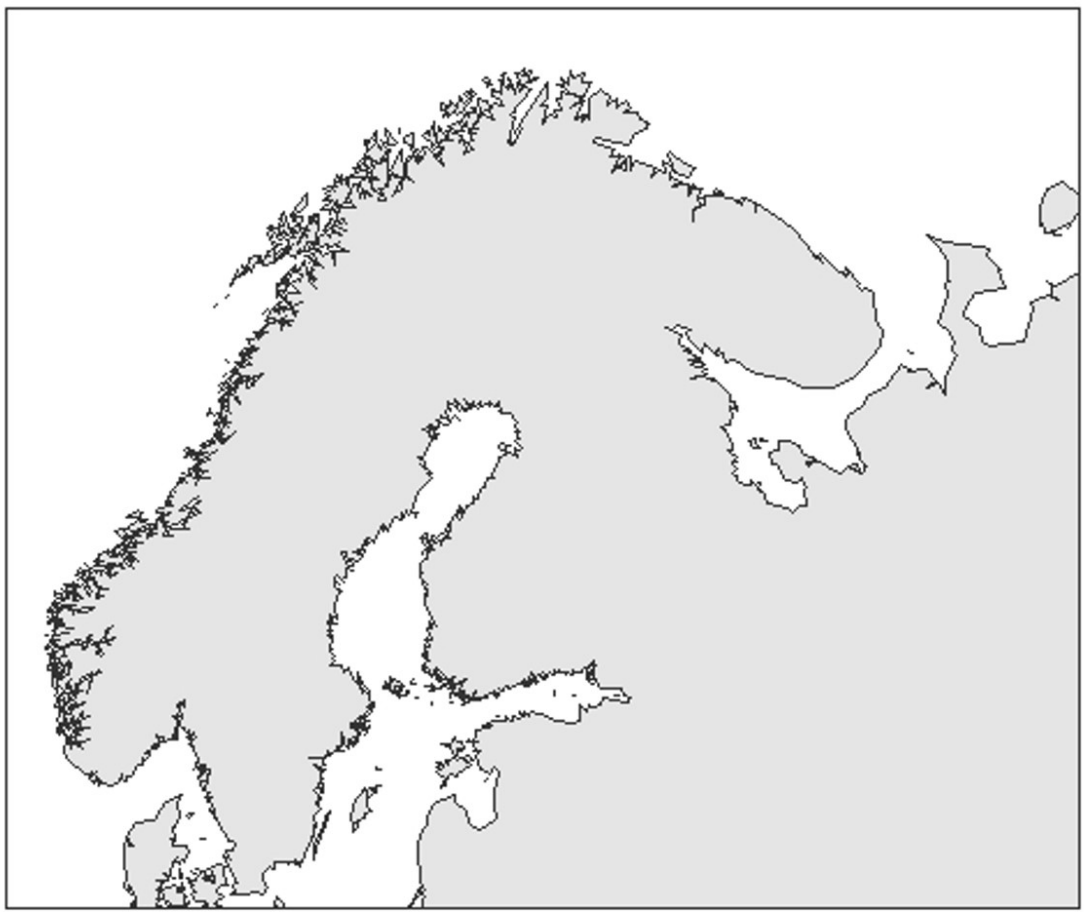
Prehistory

Where we are?



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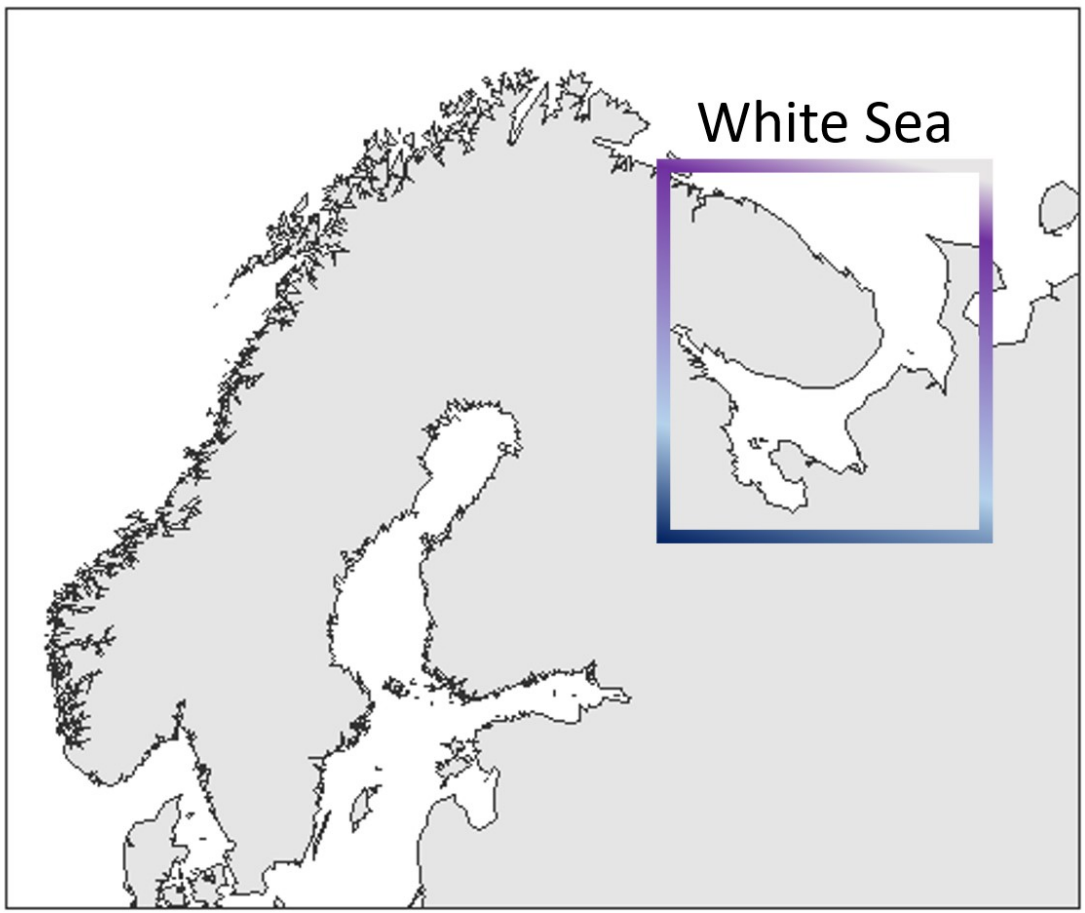

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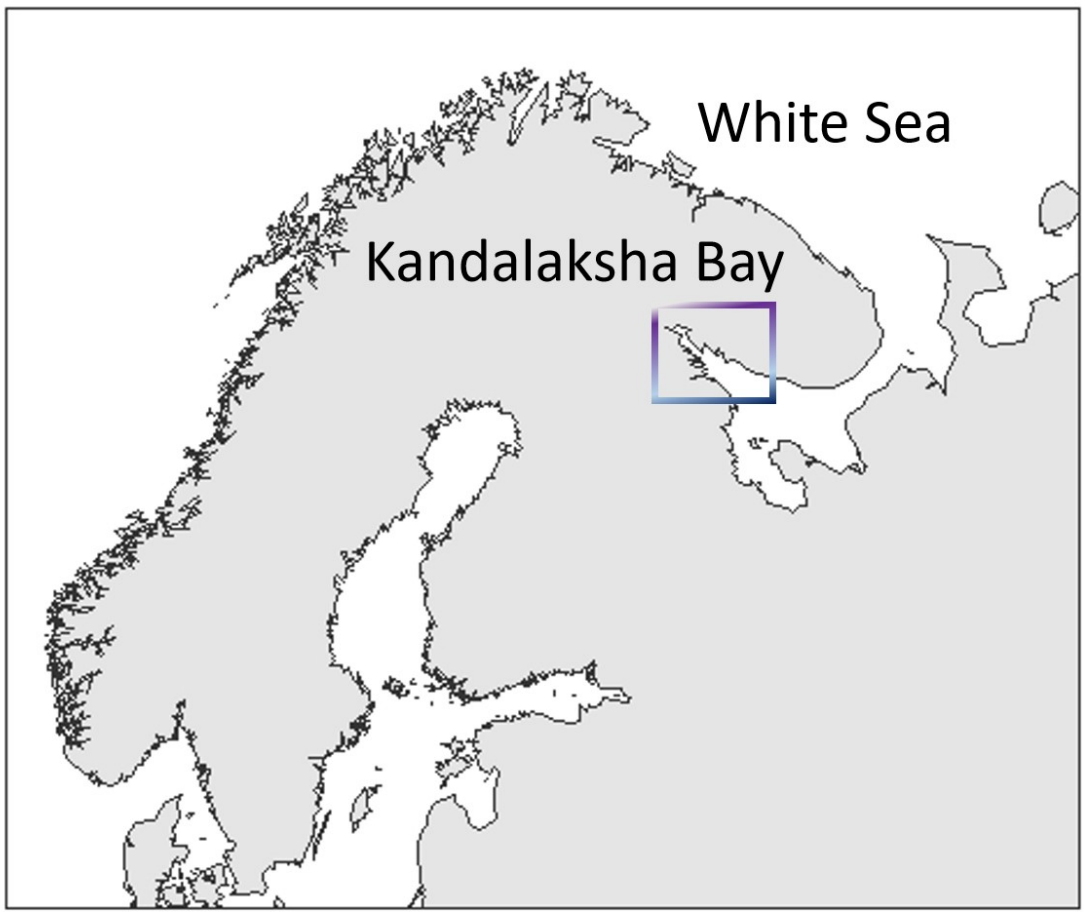
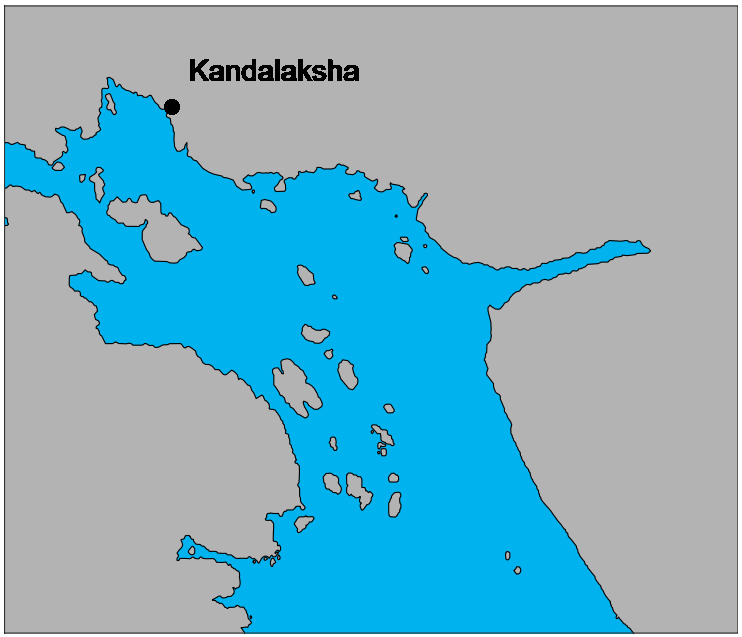


Upper part of the Kandalaksha Bay: an area with a very difficult environment



- High diversity of hydrological conditions
  - Distinct gradients of salinity due to fresh water discharge from several big rivers
  - The coastline is well indented with numerous islands, sheltered bays and exposed shores
- Active sea port and industrial town Kandalaksha is situated in neighbourhood with territory of Kandalaksha Nature reserve (anthropogenic influences are highly expectable)

Long-term observations in Kandalaksha Nature Reserve

- In 1970-th **Eugeny Ninburg** developed the program of long-term observations of marine benthic communities in Kandalaksha Nature Reserve.
- However the rules of Nature reserve, rolled in those time, prohibited active hydrobiological samples near shoreline due to nesting and nursing of sea birds
- Therefore, the time of annual collection of samples had to be shifted to winter

Ilistaya inlet

- Initially the long-term observations were set up in Rhyazhkov island
- Later the obsevation site was shfted to the small inlet situated near Luvenga village

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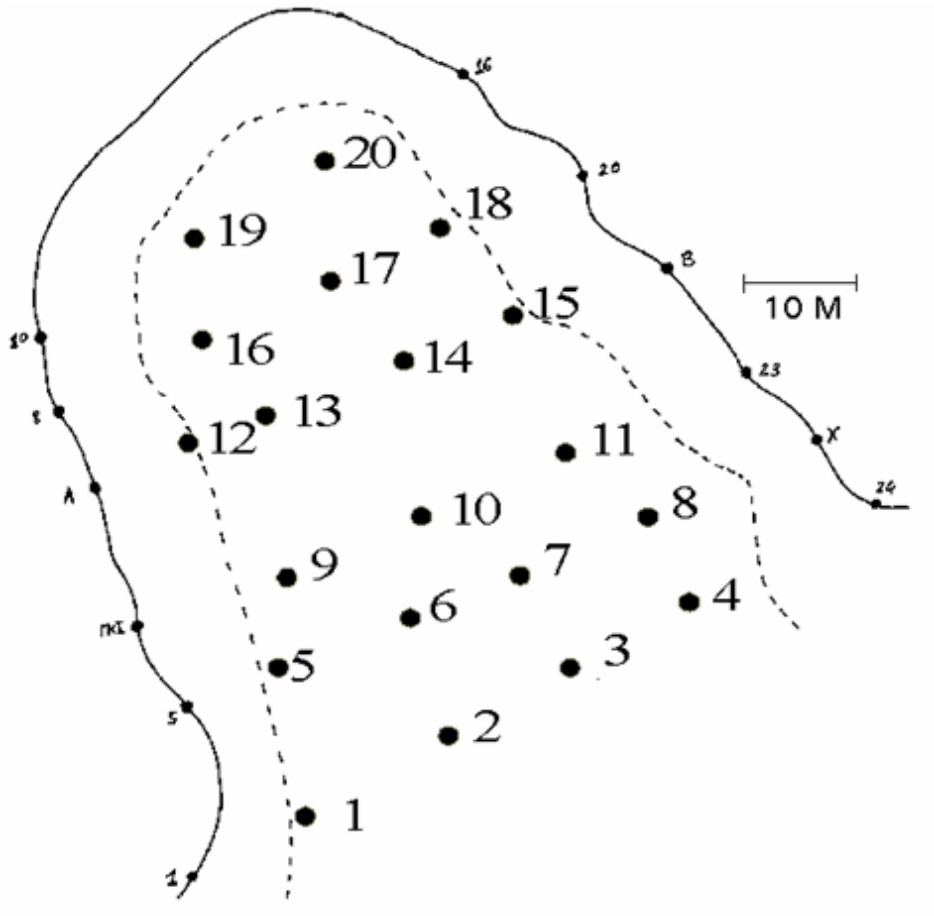
Ilistaya inlet

- In 1977 the first samples were made
- Since January 1987 annual samples were started

Ilistaya inlet



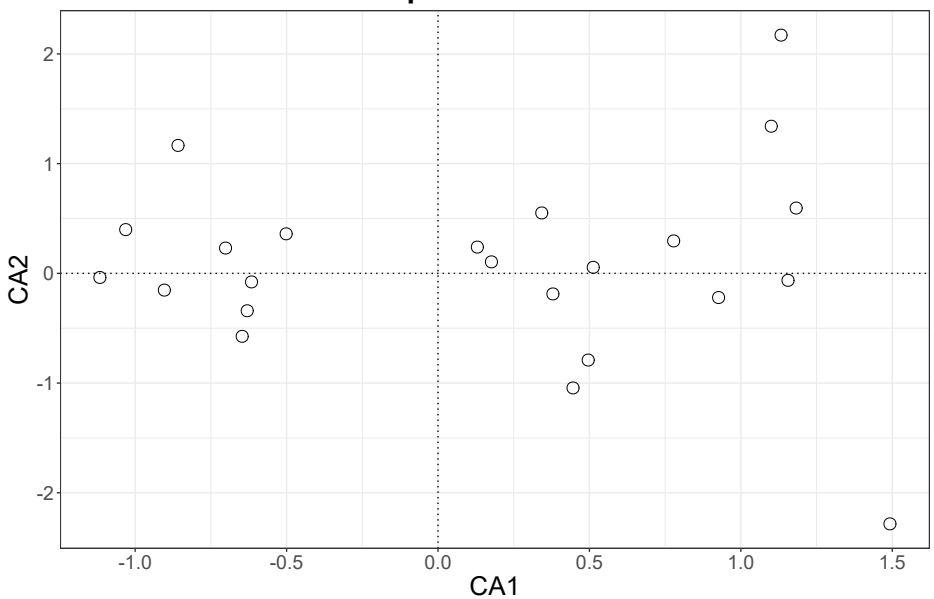
Processing protocol

- 20 standard stations are evenly distributed
- Petersen grabber ($1/40m^2$) is used for sampling
- 4 samples per each station but material of all grabs from one station pooled (total area of sampling per each station $1/10m^2$)
- Samples washed through sieve-screen with holl diameter 0.5 mm
- After quantitative sorting all taxa identified to lowest possible taxonomic level
- Abundance and Biomass assessed for each taxa
- No environmental parameters are assessed instead of sea-ice thickness and water temperature

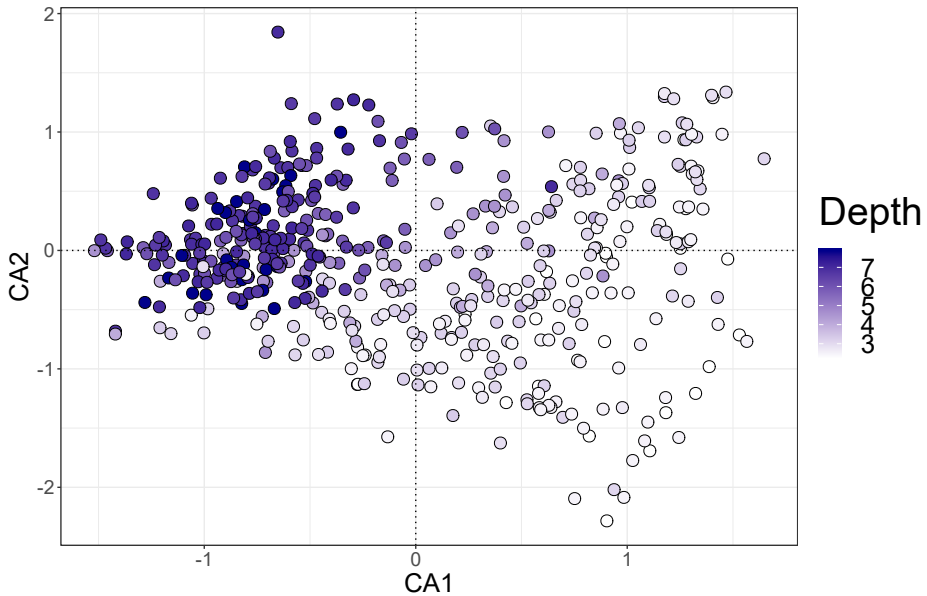
Benthic communities of the Ilistaya inlet

General characteristic of communities

Most abundant species

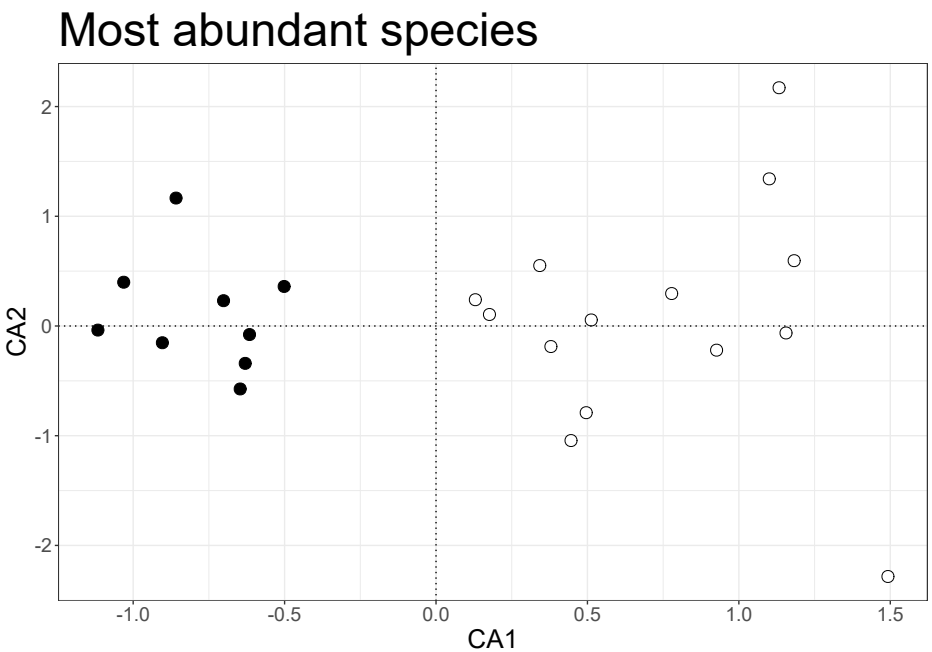


Stations



- Two distinct soft bottom communities have been revealed in the Ilistaya inlet

What is the nature of the communities?



Soft bottom community of deep water

Aricidea nolani

Diastylis glabra

Macoma calcarea

Micronephthys minuta

Praxillella praetermissa

Pygospio elegans

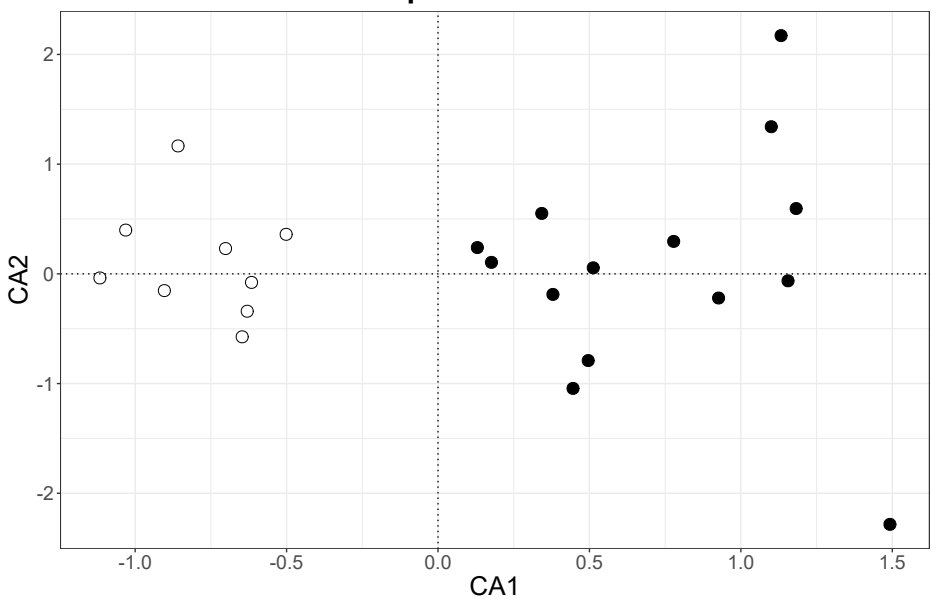
Scoloplos armiger

Terebellides stroemi

Tridonta borealis

What is the nature of the communities?

Most abundant species

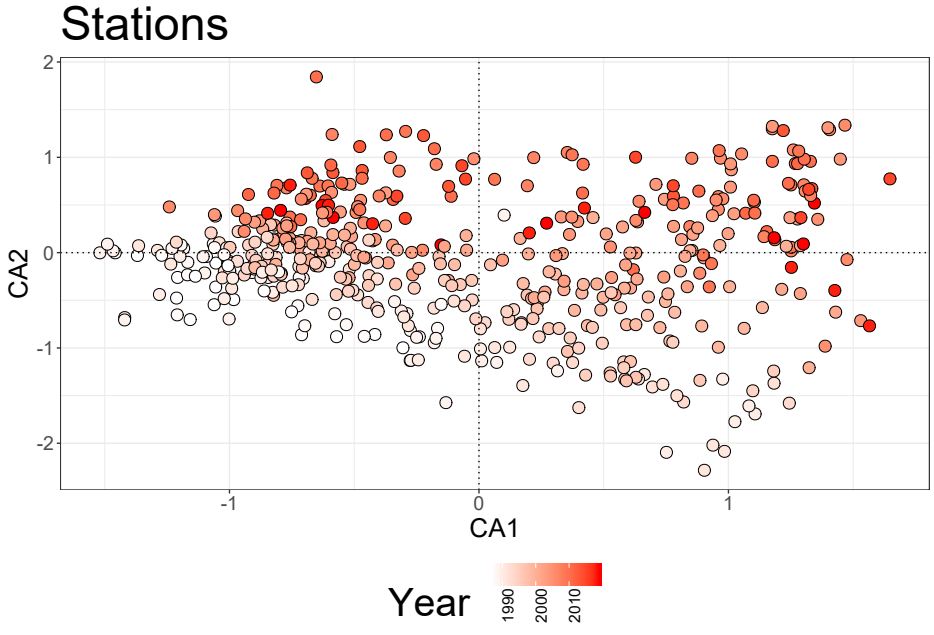


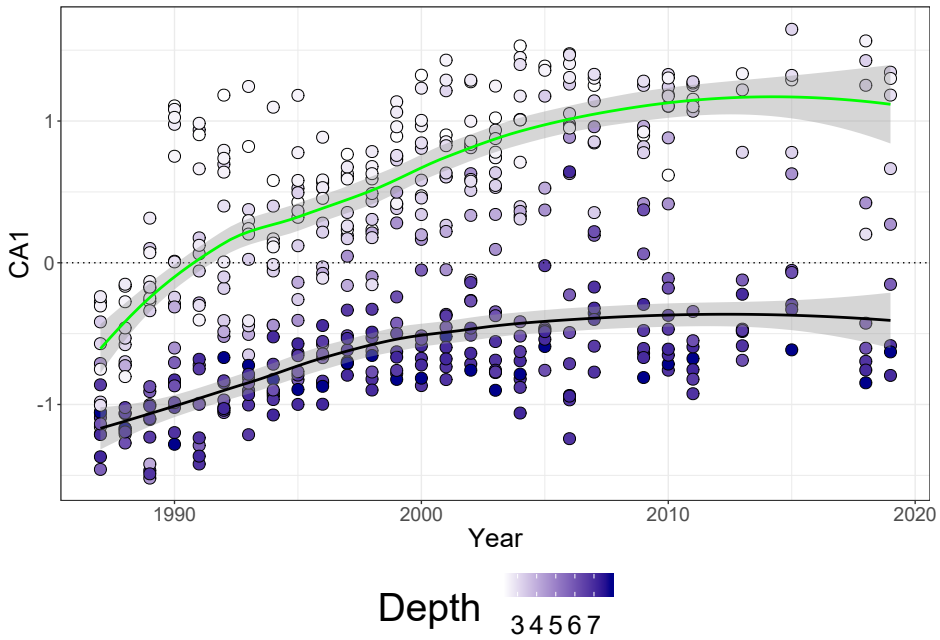
Shallow water community

Arenicola marina	Mytilus edulis
Asterias rubens	Nemertini
Atylus carinatus	Onoba aculeus
Capitella capitata	Polydora quadrilobata
Filamentous algae	Pontoporeia femorata
Hydrobia ulvae	Priapulus caudatus
Macoma balthica	Tubificoides benedeni

Commumity dynamics

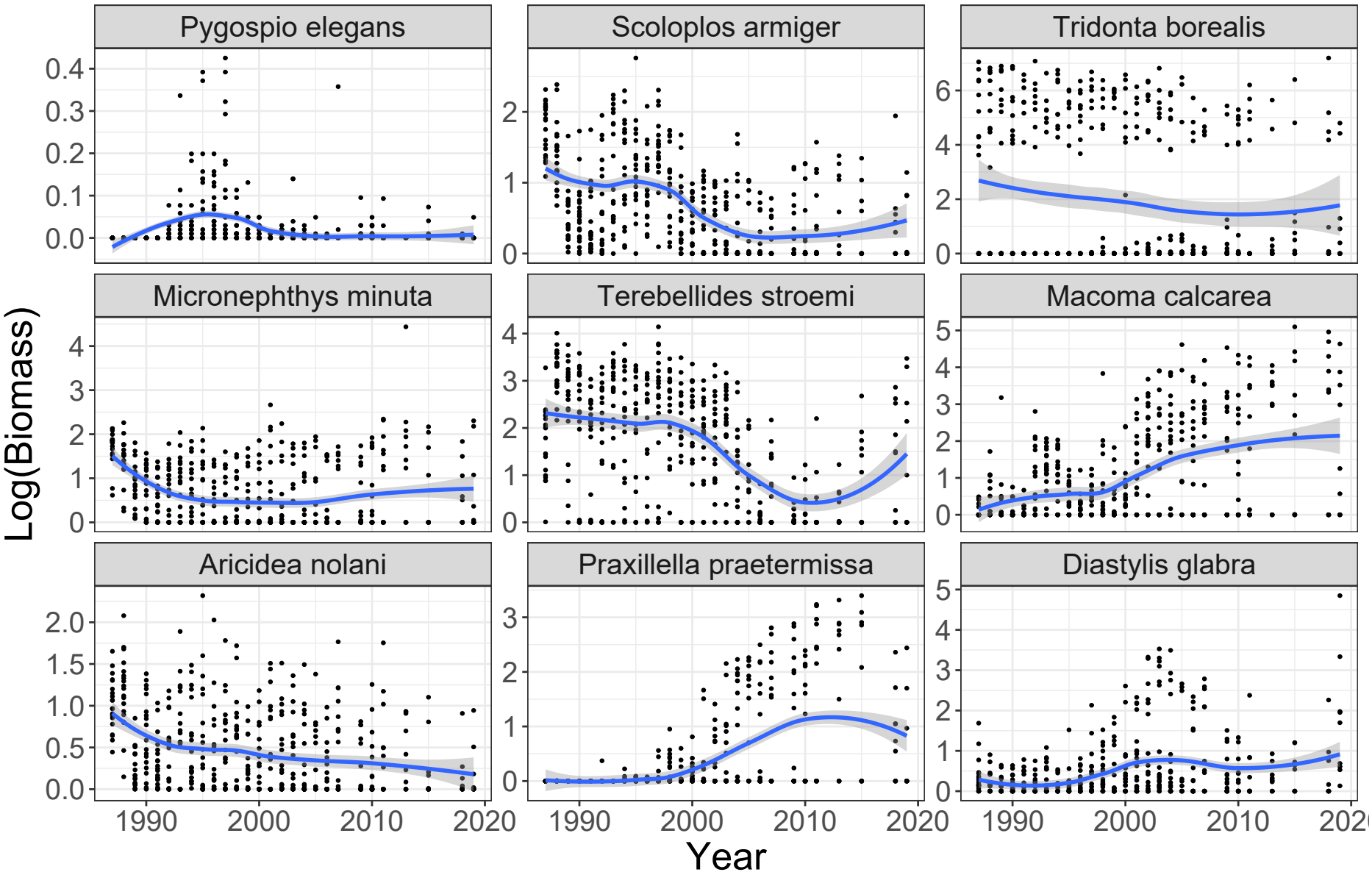
General characteristic of community dynamics



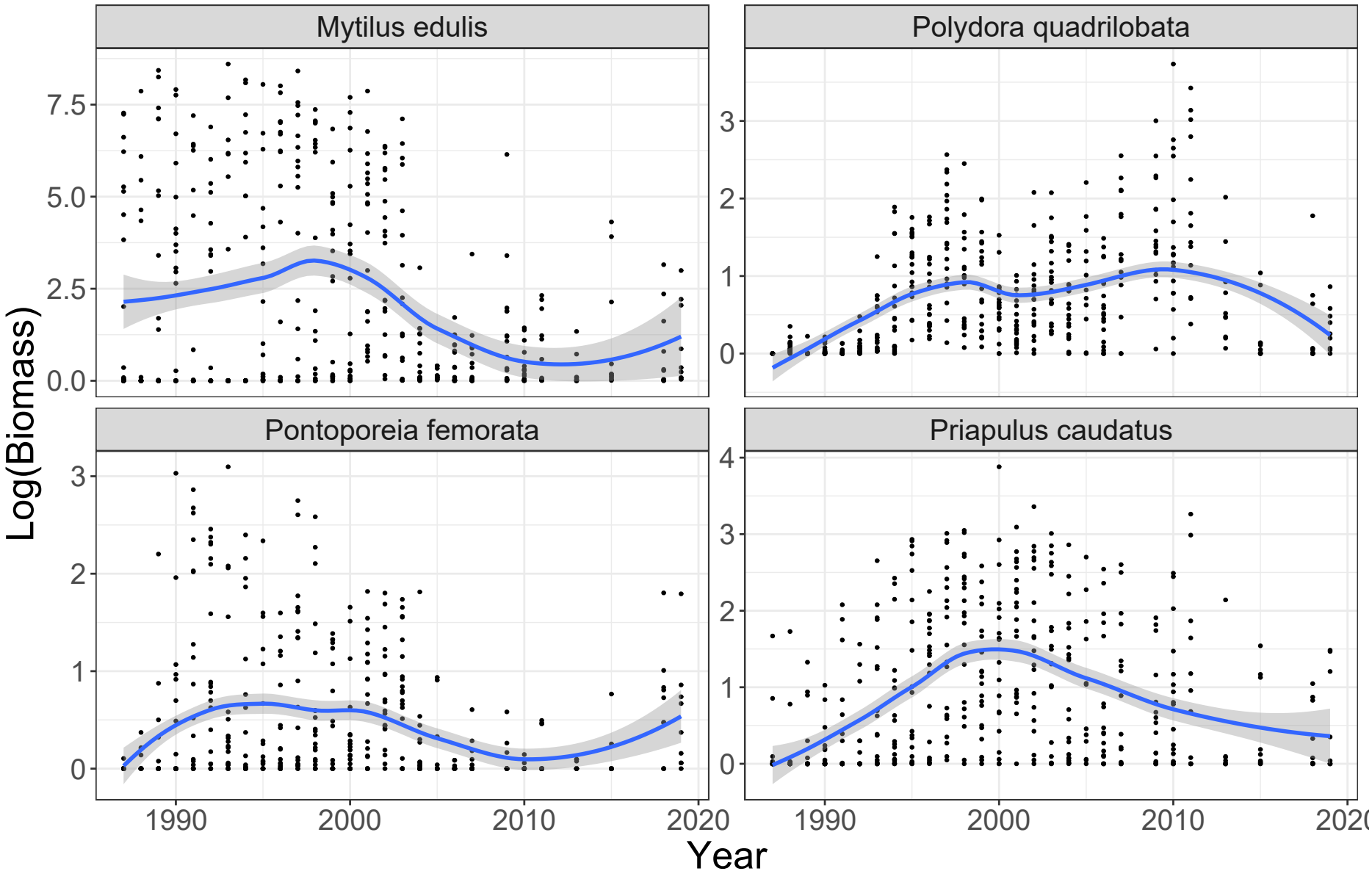


- Significant changes in community structure has been revealed during the observation
- The most powerfull changes were associated with shallow water part of the Ilistaya inlet
- In the beginning of the observation deep water community was presented at all parts of the Ilistaya inlet. However after 1990-th this community was replaced by community of another type.

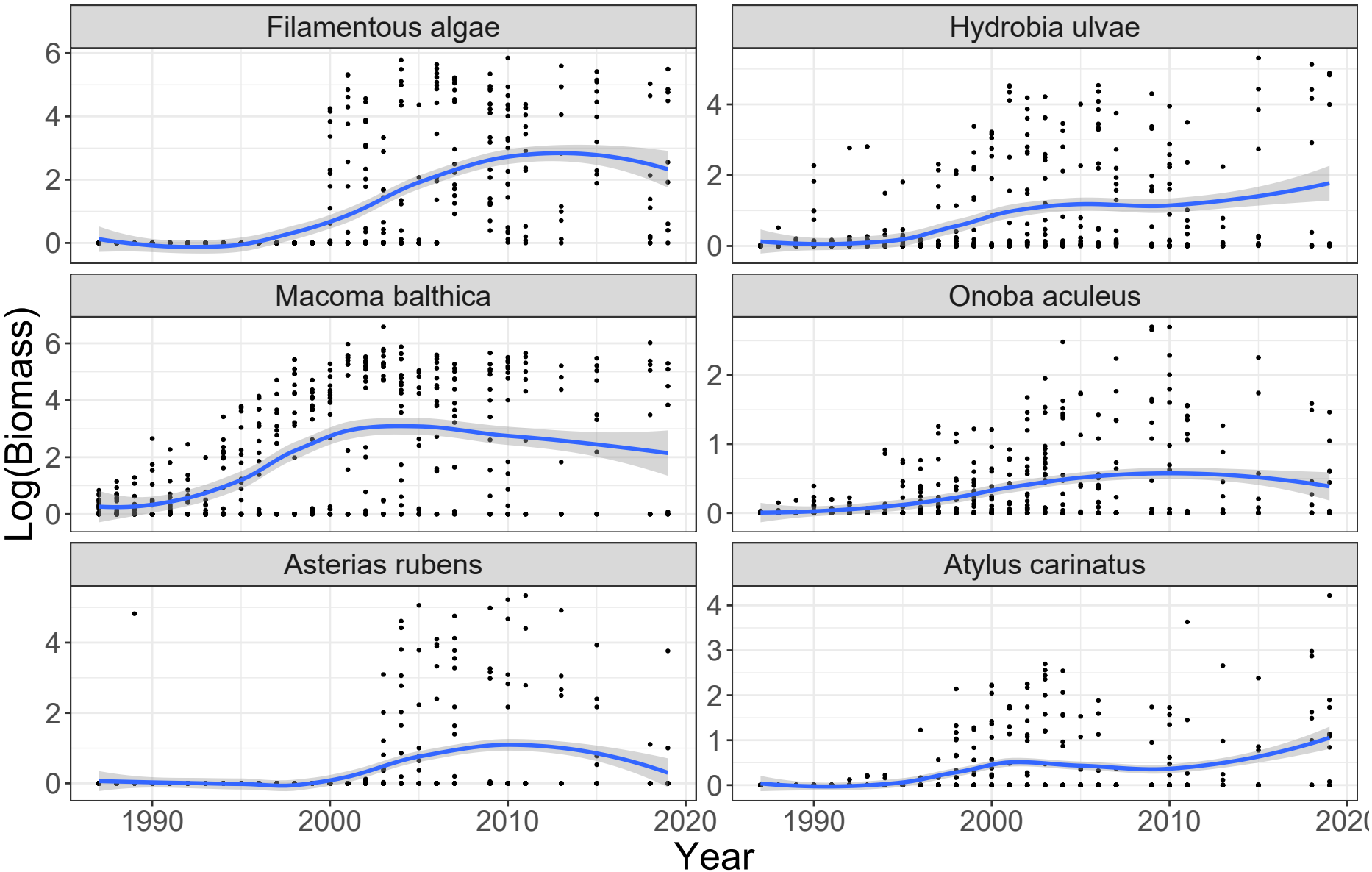
Dynamics of members of deep water community



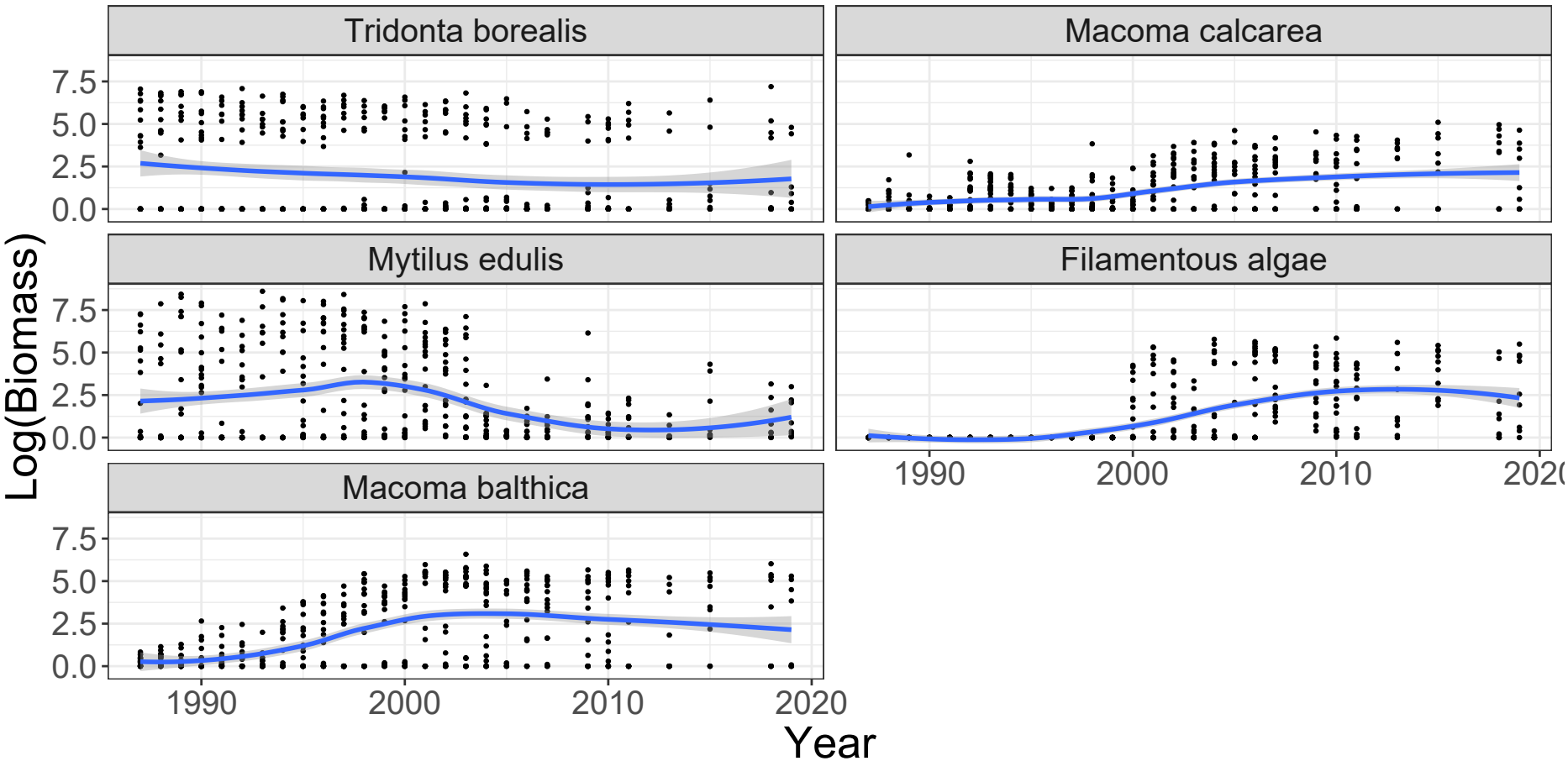
Dynamics of members of shallow water community



Dynamics of members of shallow water community



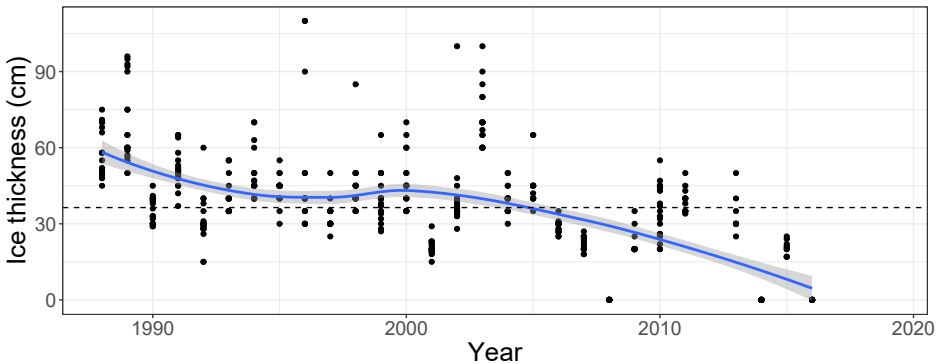
Dynamics of the most abundant taxa

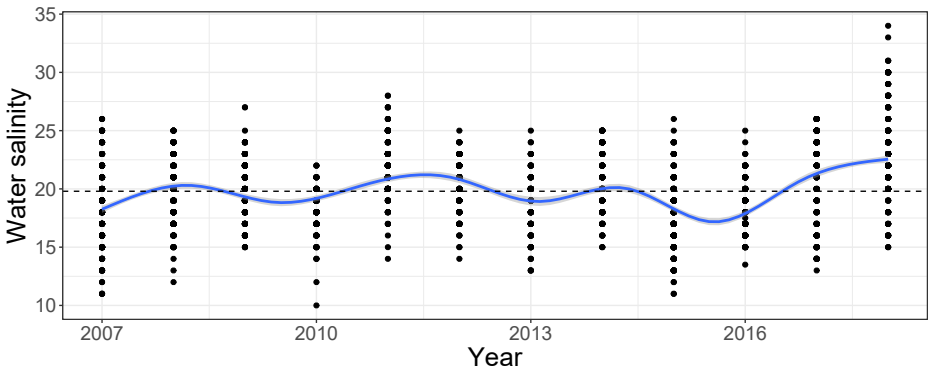


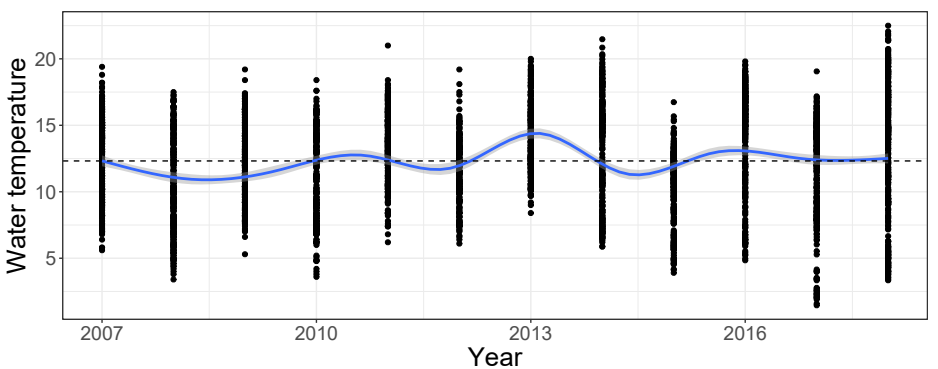
- *Tridonta borealis* was partly substituted by *Macoma calcarea* in the deeper part of the inlet
- The numerous *Mytilus* drusses dissapiered in the shallow part of the inlet and dense carpet of Filamentous algae started to cover the bottom. Under algae carpet *Macoma balthica* took the dominant position.

What is the reasons of changes in communities?

Climate changes?

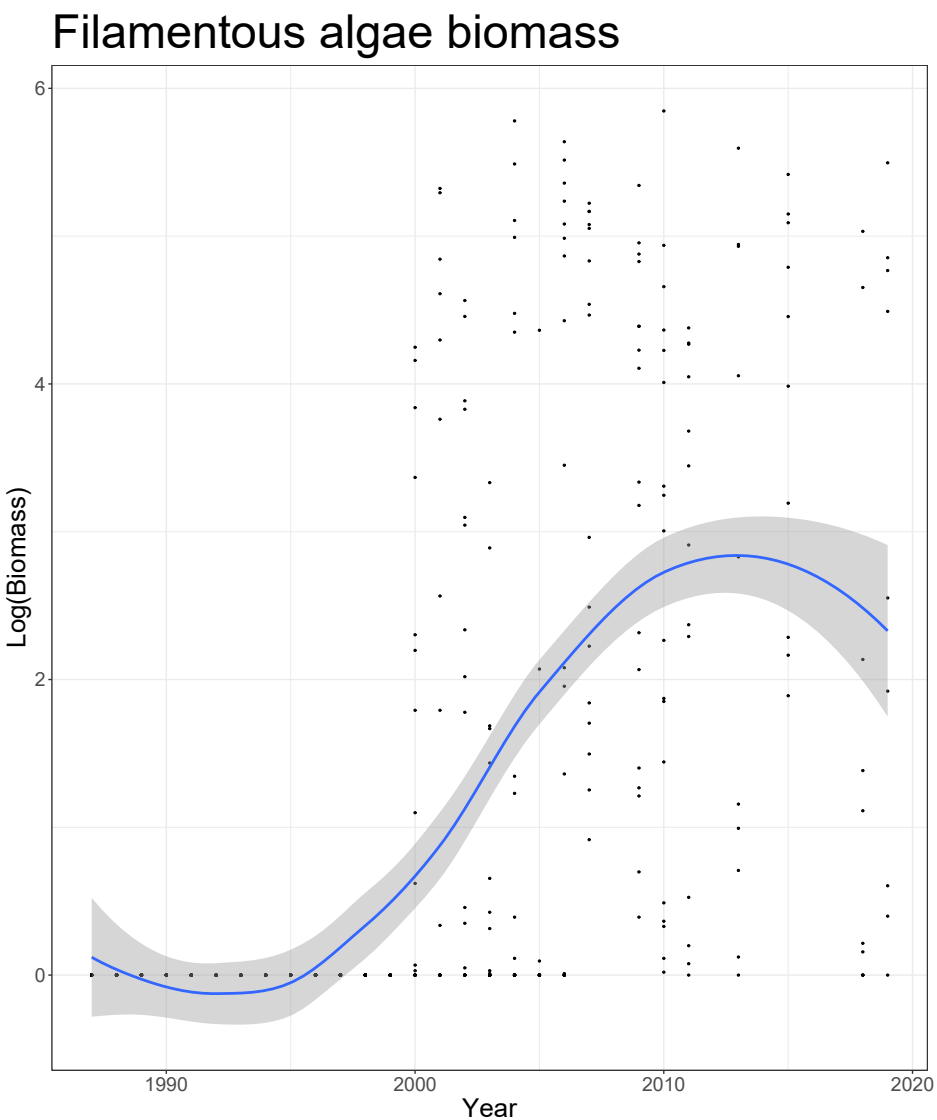






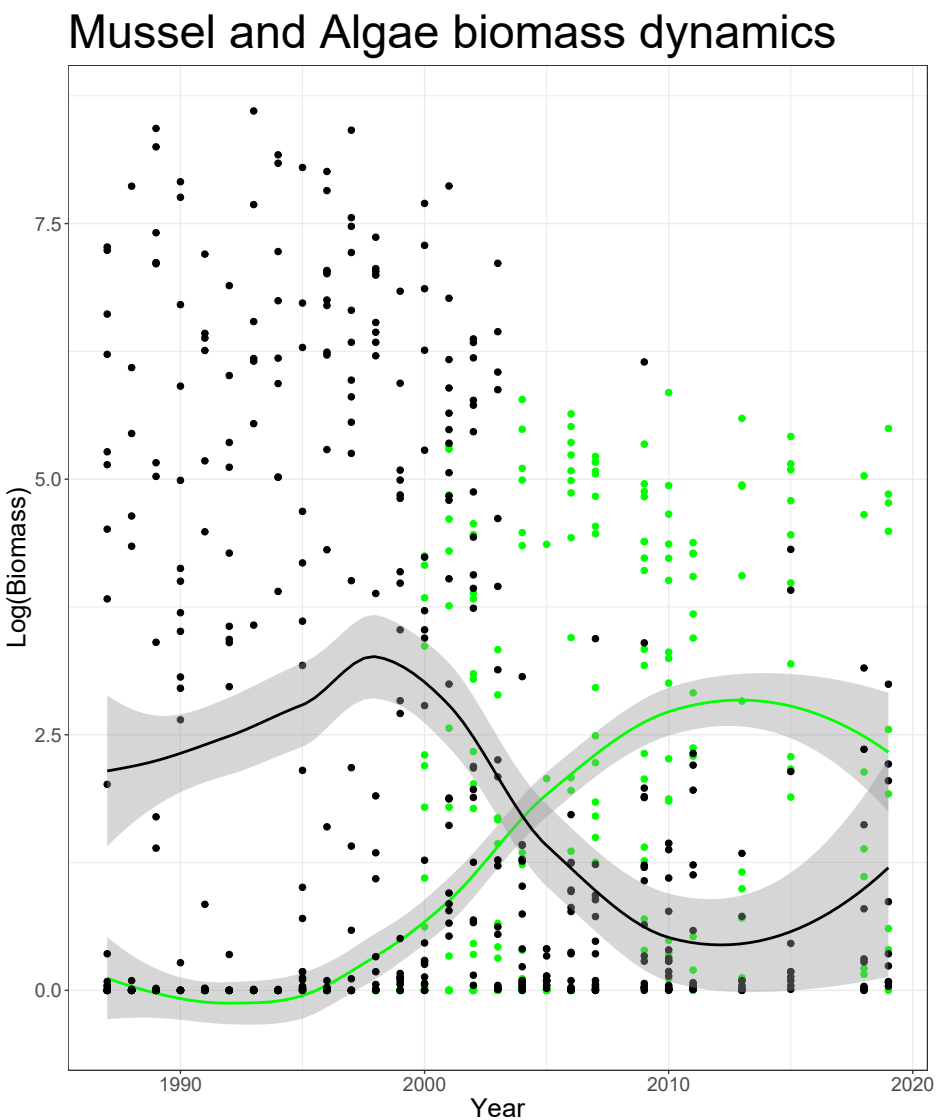
- Winter's conditions started to be much more mild in the last decades
- Less ice cover has been observed in the last decades
- Changes in other climatic parameters are also possible

Anthropogenic influence?



- Rapid growth of filamentous algae is possible only with a powerful influx of nutrients (nitrogen and phosphorus)
- There are numerous examples of “green-tides” associated with anthropogenic influence
- However algae bloom in the Ilistaya inlet seems to be a local fenomena…
- Nowhere in other sites of long-term observations we have not seen such expansion of filamentous algae. May be I don’t know something?

Natural biological process?



- Dense assemblages of mussels demonstrate long-term cyclic changes associated with periodical mass extinction of old mollusks (Naumov, 2006; Khaitov & Lentsman, 2016)
- It is wellknown that mussels stimulate growth of filamentous algae due to influx of nutrients (Kautsky, Wallentinus, 1980; Baroli et al., 2003; Khaitov et al., 2008)
- Cycles of periodic overgrowing of mussel beds by filamentous algae were observed in other sites of long-term observation
- However, why such long process?…

Resume

- Subtidal soft-bottom communities of Ilistaya inlet are not stable: the most powerfull changes were revealed in shallow water part of the inlet
- Mass bloom of filamentous algae was observed in the inlet after 2000-th
- Community of burrowing mollusks and polychaetes was rpelaced by community associated with dense assemblages of mussels and next by community associated with carpet of filamentous algae
- Crucial changes in shallow water part of the inlet influented on deep water part aswell: some species associated with filamentous algae community expanded to deep water part of the inlet
- The mechanisms of the changes observed are unknown but my be associated both with external influences (climate changes, anthropogenic influence) and internal interactions e.g. with natural dynamics of dense assemblages of mussels.


Thanks for attention!