Mussel farming in the Curonian Lagoon - challenges and perspectives

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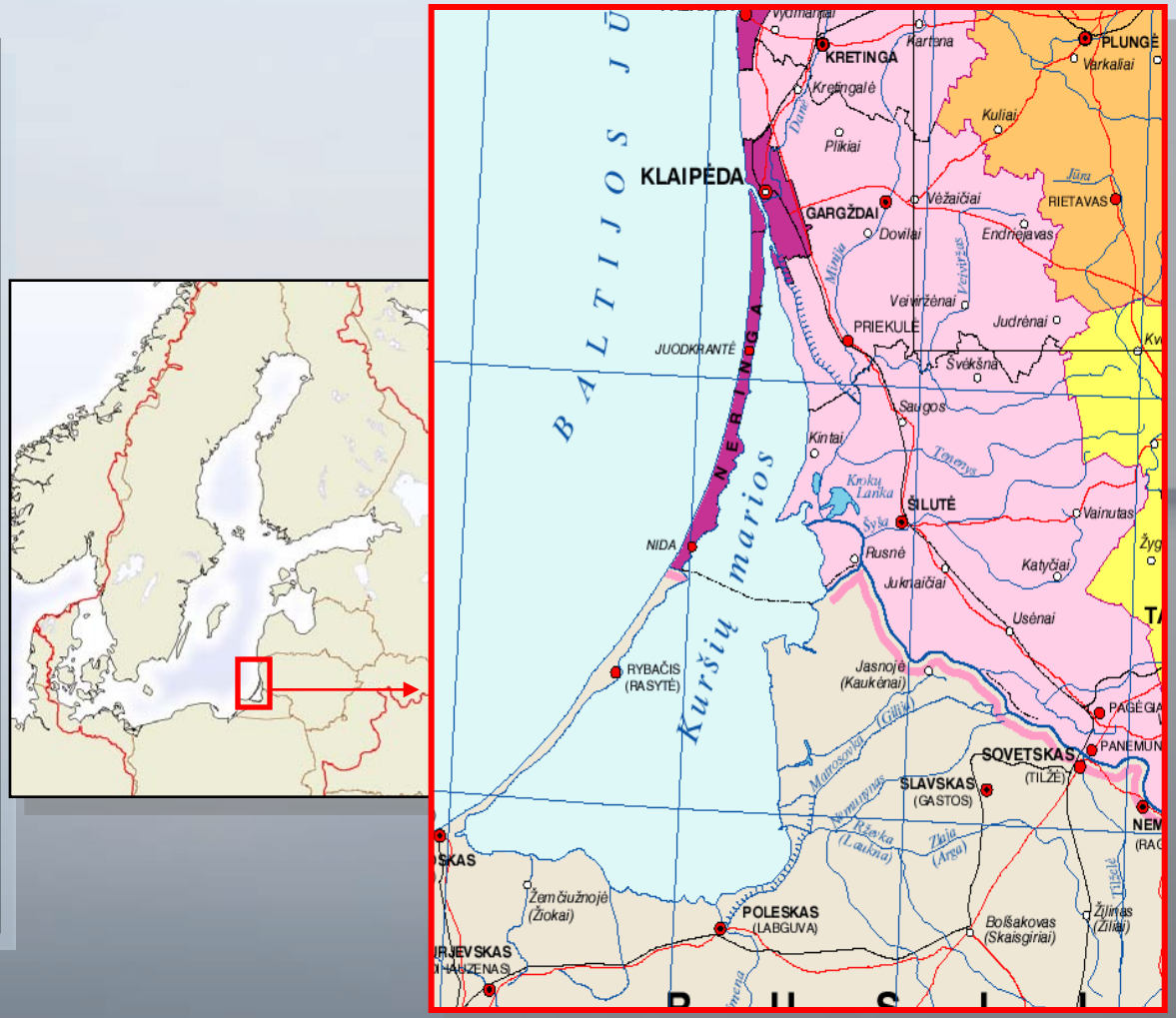
Ecological features of the Curonian Lagoon

- **Depths, m:**
  mean 3,8 m; max 5,8 m;
- **Salinity, PSU:**
  0<S<3,0 (up to 5-6 eventually)
- **Temperature range ^{0}C:**
  0-24 (max 27) ^{0}C
- **Main bottom substrate:** sand, silt, shell deposits
- **Native macrofauna species richness:**
  ~80 species and higher taxons (mostly freshwater)
- **Riverine runoff:**
  23 km ^{3} annually, main discharge – from Nemunas river (98 %)



Featuring problems of the Curonian Lagoon

- The Lagoon's area is about 1584 km^2
- Its basin area is 100500 km^2
- The main ecological problem is anthropogenically induced euthrophication
- During the last two decades increase in nutrients concentrations and phytoplankton abundances was reported

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Why zebra mussel cultivation?

- According to the EU WFD, all the surface waters should reach a good ecological status by 2015
- This objective needs more effort and is less certain, since the water quality of the Lagoon cannot be sufficiently improved through river basin management alone
- Several studies have addressed the potential use of zebra mussels in water quality remediation

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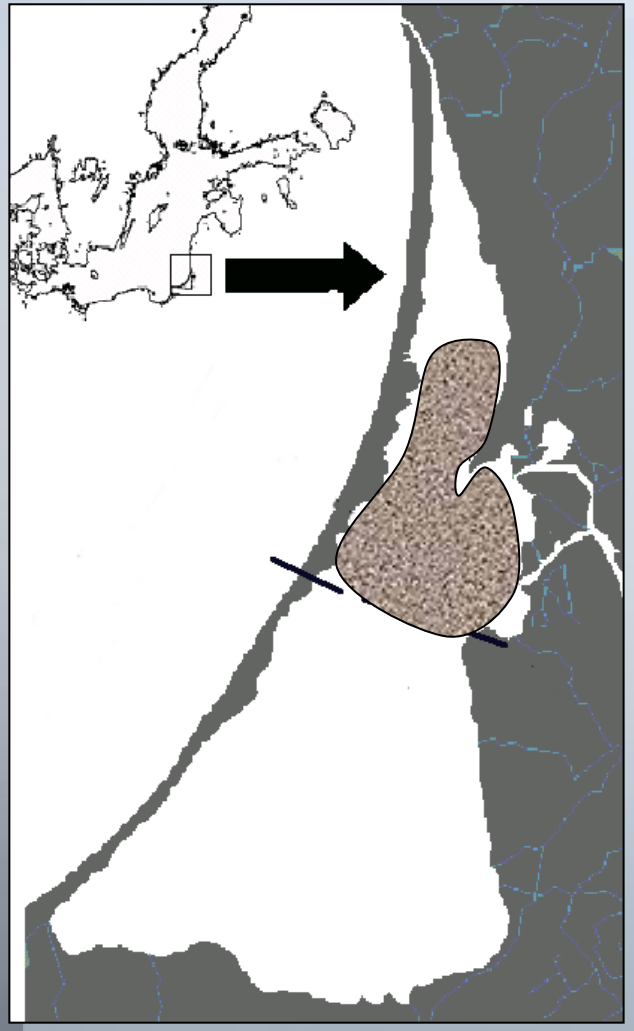
The current zebra mussel resources



- The zebra mussel has established population in the Lagoon for at least 200 years
- It is abundant from the upper littoral to 3-4 m depth
- The largest area (about 300 km^2) occupied by the zebra mussel community is located in the central part of the Lagoon
- The estimated biomass of living zebra is about 140000 t
- The zebra mussel distribution is limited by several factors:
  - brackish water inflows from the sea
  - hydrodynamic conditions
  - availability of suitable substrates

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Challenges of the zebra mussel cultivation in the Curonian Lagoon

- Shallowness and hydrodynamic conditions of the ecosystem
- Pronounced seasonality
- Fishing activities
- No aquaculture experience…

- Uncertainties related to the:
  - Zebra mussel productivity
  - Larvae viability and settlement
  - Clearance rates of the mussels and filtration effectiveness
  - Possible impacts of artificially increased zebra mussel population
  - Perspectives of the harvested zebra mussels utilization

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Main activities anticipated within SUBMARINER

- To analyse the environmental conditions with regards to ecological and economic threats and benefits of the zebra mussel aquaculture development :
  - Evaluation of the possible effects on hidrochemical parameters in the Lagoon;
  - Impact of zebra mussel filtration and oxygen consumption on ecosystem;
  - Biodeposition of suspended matter and its possible impacts.
- To analyse the socio-economic perspectives of the zebra mussel cultivation:
  - Growth, production and metabolic rates of the zebra mussel in the Lagoon;
  - Concentration and accumulation of different hazard substances in zebra mussel tissues, at the different life stages;
  - The zebra mussel infestation level by endoparasites;
- To analyse the zebra mussel cultivation technology and application:
  - Modelling of the optimal zebra mussel farm capacity and location
  - Stakeholders identification and selection of the appropriate site
  - Projecting and essay of the proper zebra mussel farm construction

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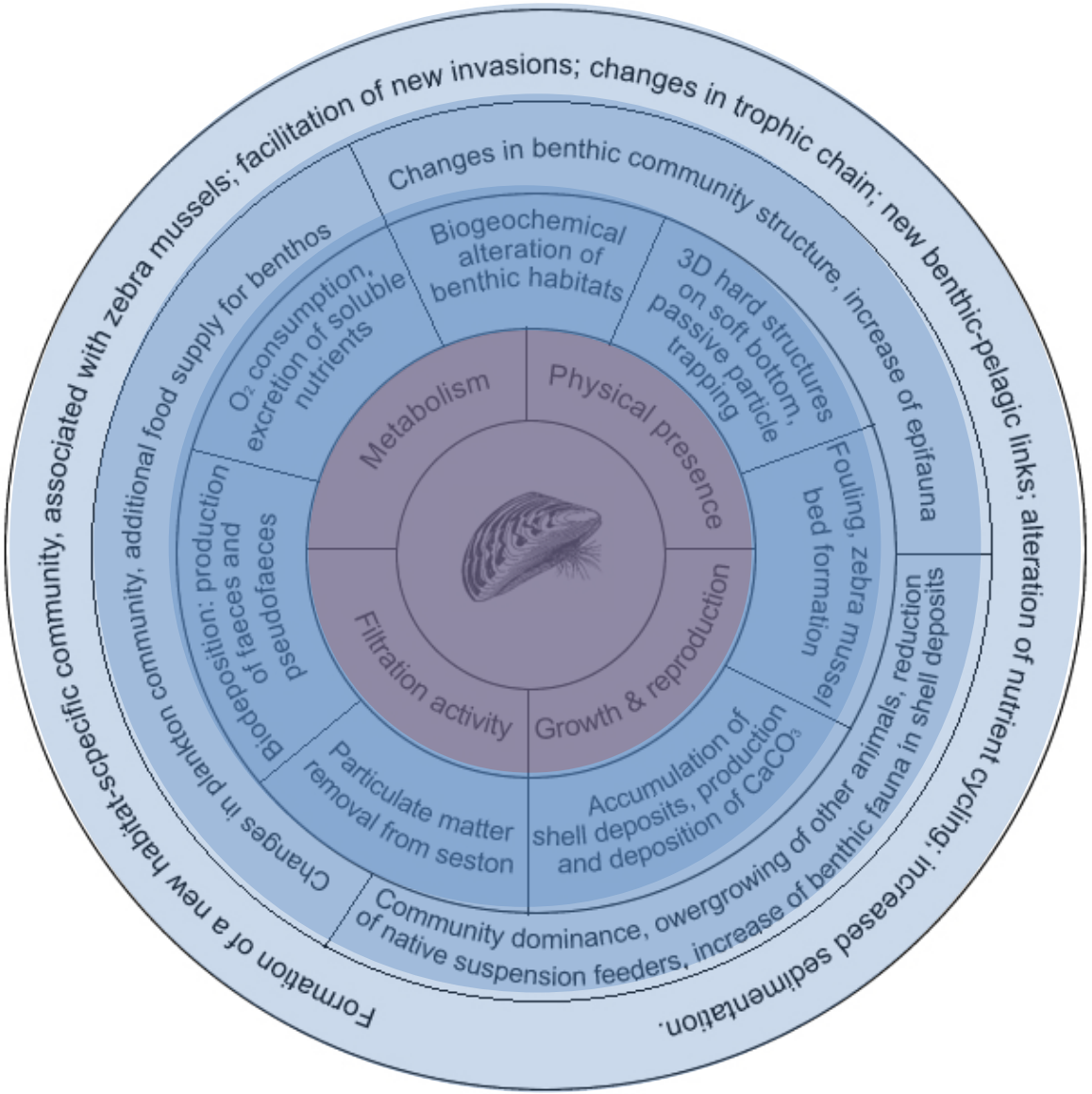
Principal functions of the zebra mussel and several levels of possible impacts



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Relevant experimental studies being performed

- Seasonal dynamics and viability of the zebra mussel larvae in the Curonian Lagoon (August 2010 – October 2011).
- *In situ* experiment on the zebra mussel larvae settlement at different sites of the Lagoon (April 2011 – October 2011).
- Seasonal dynamics and diversity of the zebra mussel endoparasites in the Curonian Lagoon (April 2011 – October 2011).
- Experimental study of the zebra mussel filtration-biodeposition efectiveness under high turbidity conditions.
- Experimental study on the respiration-excretion-calcification rates of the zebra mussel.

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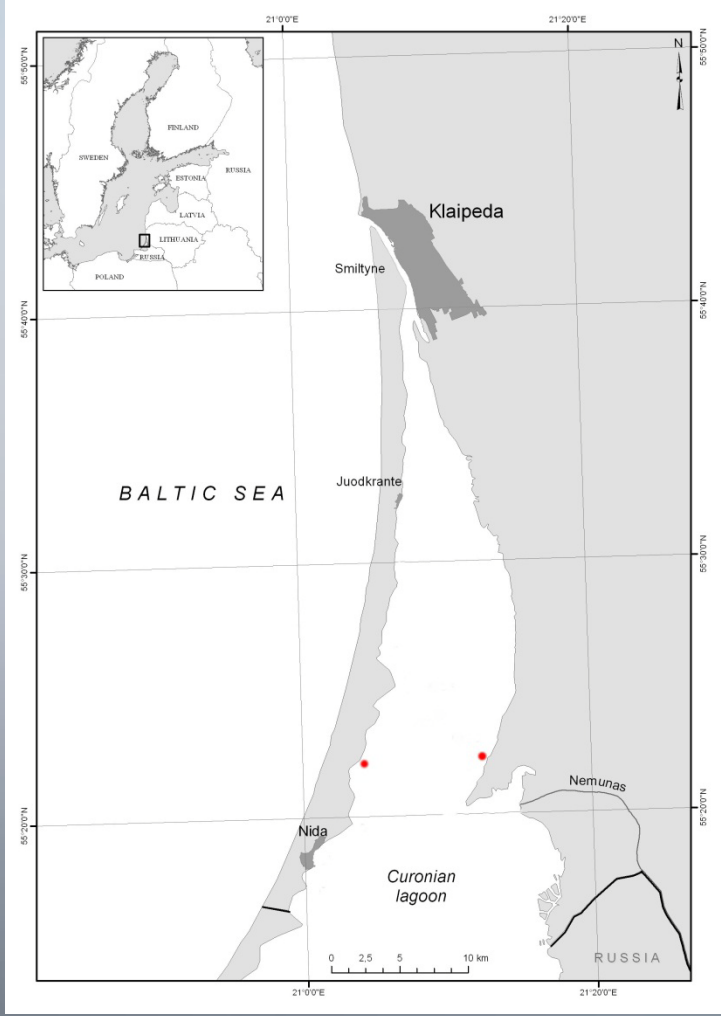
Experimental zebra mussel farm



- Two sets of the experimental mussel farm prototypes (long-line mussel farm type) were purchased and installed in the littoral of the Curonian Lagoon
- The installations will be held at sites during the potential zebra mussel reproduction period (April – October) and monitored every two week for larvae concentrations and viability
- At the end of the experiment, the collectors will be removed and characteristics of settled mussels will be assessed (wet and dry biomass, lengths, shell dry weight, etc.).

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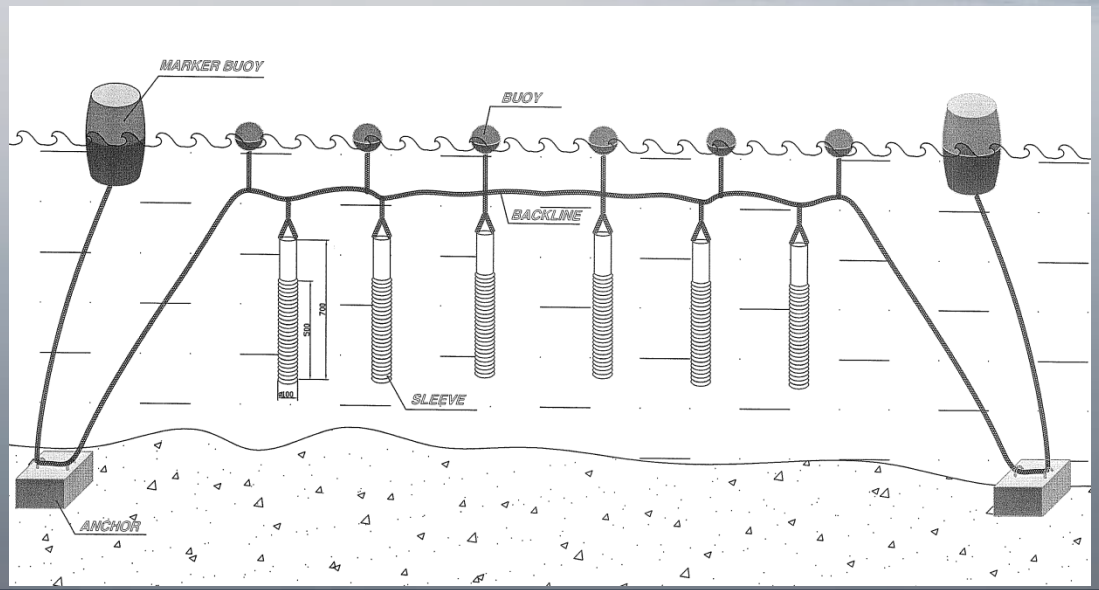
Factors under concideration

- Cover material of the sleeves (collectors) – synthetic vs. natural
- Location of the farm – eastern vs. western shore
- Orientation of the line – along the main current or across the main current



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Infestation level with endoparasites

- The diversity and abundance of endoparasites and endosymbiontes is considered for two size groups of the zebra mussels: <10 mm and >20 mm
- The preliminary results of the zebra mussel parasitological analysis have indicated that there are 2 species of ciliates dominating in the Curonian Lagoon mussels:
  - *Conchophthirus acuminatus* (Clapare`de & Lachmann, 1858)
  - *Ophryoglena sp.*
- Infestation level with nematodes is rather low (less than 6% of examined mussels were infested), and was registered only for mussels with shell length of 20mm or more.
- Overall infestation level of the smaller individuals is significally lower than of the bigger ones

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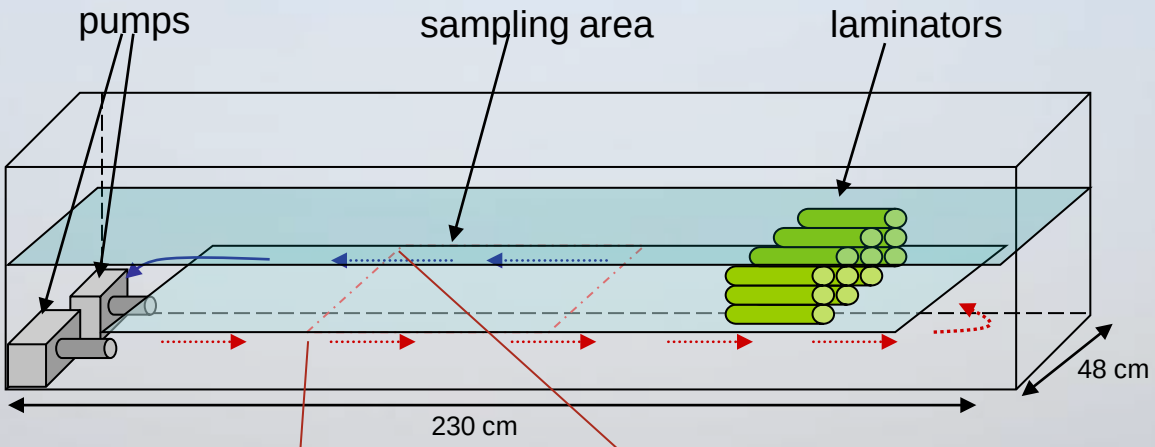
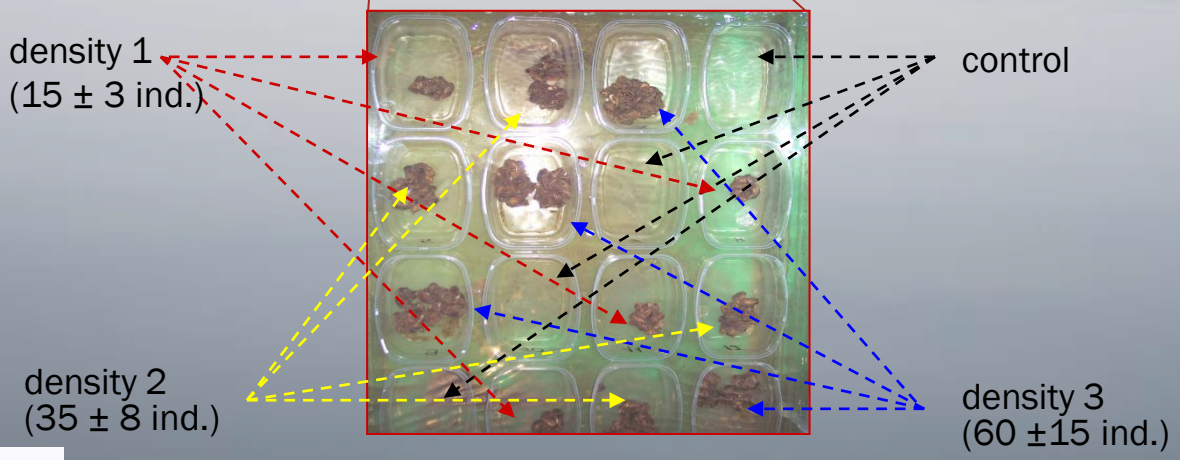
Zebra mussel filtration-biodeposition experiments





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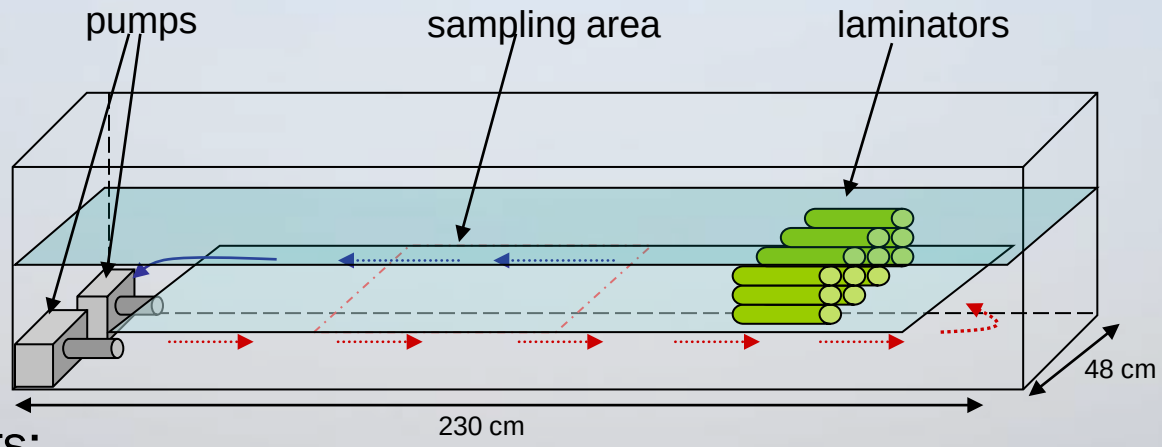

Measured parameters:

- total particulate matter (TPM), particulate inorganic matter (PIM) and particulate organic matter (POM) concentrations in the flume before the installation and once per day during the experiment
- TPM, PIM and POM concentrations in the sediments of the experimental vessels, at the end of the experiment
- weights of the zebra mussels (WW and SFDW) and densities of the clumps

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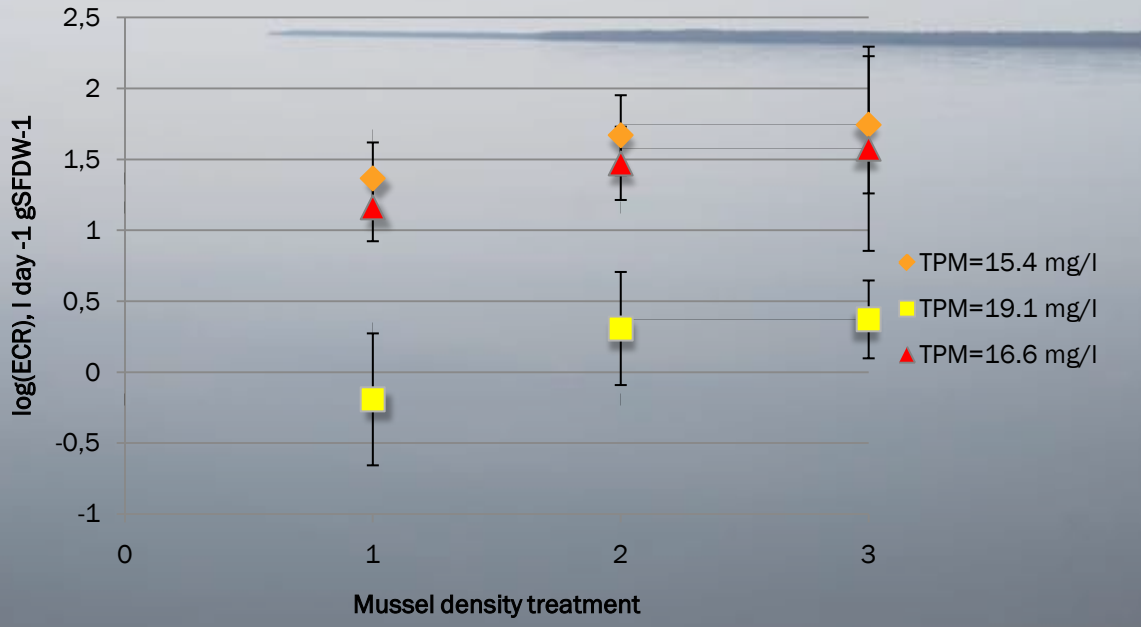
Results and conclusions

- In extremely turbid waters, under limiting particulate matter concentrations, zebra mussels may exhibit low filtering efficiency and consequently low growth potential
- In such ecosystems (as Curonian Lagoon is) densely aggregated zebra mussel populations should be more effective for remediation purposes rather than those sparsely distributed
- *Id est*: the zebra mussel cultivation facilities should be constructed to ensure the dense aggregation of mussel colonies



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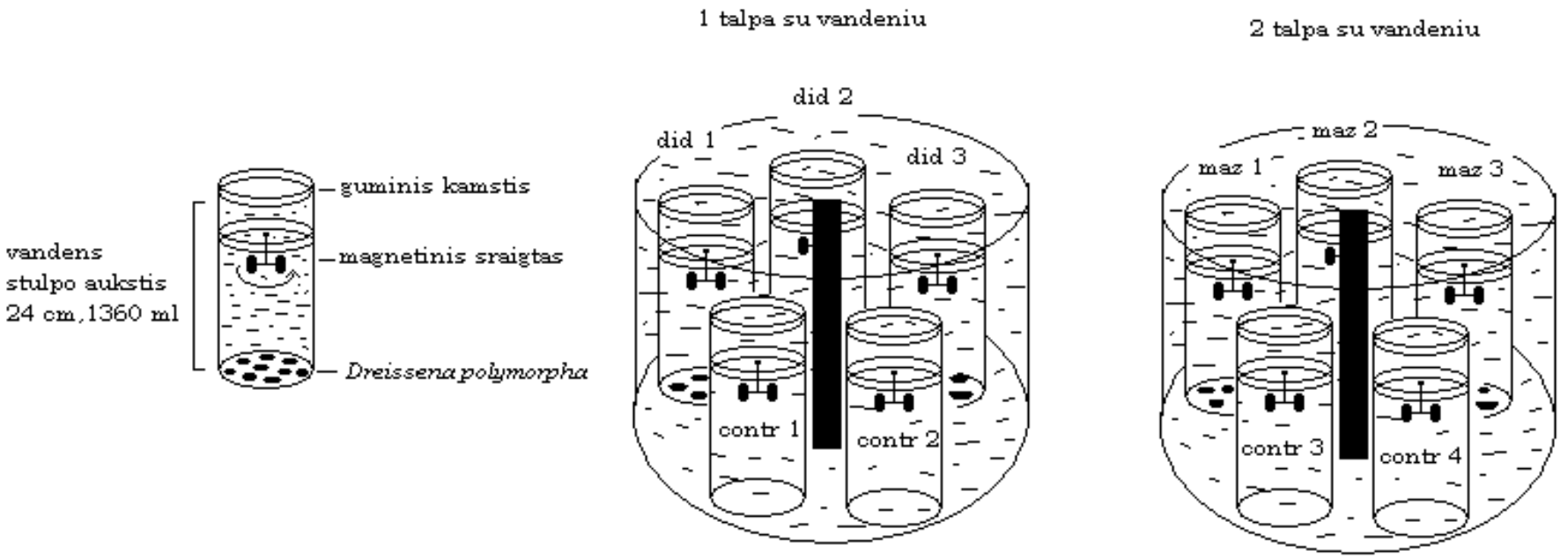
Incubation laboratory experiment on the zebra mussel respiration-excretion-calcification rates



- The respiration-excretion-calcification rates of the 2 size groups of the zebra mussel are estimated by measuring O_2, CO_2, pH and NH_4 within the incubation cores prior and after the incubation and comparing to the control cores without zebra mussels.

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Future work to be done

- Fulfil the field and experimental studies, analyse and summarize the results according to the project objectives
- Analyze data on accumulation of cyanobacteria toxins in zebra mussel tissues, at the different life stages
- Perform comprehensive analysis of available information from earlier studies in order to evaluate threats and benefits of the zebra mussel cultivation adequately
- Model the optimal zebra mussel farm capacity and location
- Identify possible stakeholders and analyze the existing legislative base
- Provide project and essay of the proper zebra mussel farm construction

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Thank you for your attention!

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