Effects of increased CO$_2$ concentration in seawater on net primary production of seagrass Zostera marina L. in the brackish water ecosystem

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Study area
The Baltic Sea as a unique marine ecosystem
- very young sea
- highly isolated from ocean
- seasonally varying system
- low seawater salinity values (0-25 PSU)
- mixture of marine, limnic and brackish water species
- strong human influence – climate change, eutrophication, toxic pollution, alien species invasion

Background
Seagrasses, marine flowering plants are distributed all over the world and their communities play key roles in the coastal ecosystems.

In the brackish Baltic Sea seagrass Zostera marina is one of the most abundant macrophytes on exposed sandy bottom and is regarded as a key species of this habitat.

However, their response to acidification and climate change in brackish water is not well understood.

Research Question
The aim of current study was to detect the effects of acidification on the physiology of seagrass Zostera marina L. growing in the brackish Baltic Sea by measuring net primary production?

Experimental setup
Experiment: 15.07-27.07.2013
- Seagrass Zostera marina was incubated in mesocosms (photos 1, 2, 3) with manipulated different p(CO$_2$) levels (photos 4 and 5):
  - Treatments of p(CO$_2$) levels:
    - p(CO$_2$) = 200 µatm
    - p(CO$_2$) = 1000 µatm
    - p(CO$_2$) = 2000 µatm
- As a response variable - photosynthetic activity was measured every day by the oxygen method (photos 7 and 8).
- During experiments other environmental factors were also monitored (salinity, light, nutrients and temperature).
- In parallel, the diurnal natural fluctuation of seawater p(CO$_2$) levels were measured outside the mesocosms at 0.8 m depth in the natural shallow water macroalgal habitat.
- The concentrations of p(CO$_2$) were measured with an automatic CO$_2$ data logger (CONTROS™ DETECT 2.0).
  The pH (on the total scale) of each treatment was measured with a YSI 6600V2 environmental probe (photo 6).

Results
Environmental variables

Results of Zostera marina
The elevated p(CO$_2$) levels in seawater no significant effect on the photosynthetic activity of Zostera marina.

Increased p(CO$_2$) levels in seawater may increase the photosynthetic activity of macroalgae Furcellaria lumbricalis (2013).

Compared to other studied macroalgae
Increased p(CO$_2$) levels in seawater may increase the photosynthetic activity of Chara aspera, C. borealis and C. contraria (2012).

Conclusions
- Net primary production was higher under normal conditions.
- No significant variations between treatments, but significant change in time.
- Effects of increased CO$_2$ on the Baltic Sea seagrass Zostera marina is yet indistinct and needs a further verification.

Possible explanations:
- Design of the experiment
- High CO$_2$ or low pH is not favourable for seagrass Zostera marina that live in a highly variable pH environment.

General conclusion
- Changes in pH of coastal waters due to increased CO$_2$ will have less effect on near coastal biota due to adaptations of large amplitude of pH variability.