H43C-1505

AGU FALL MEETING
San Francisco | 14 –18 December 2015

Bioirrigation impacts on sediment respiration and microbial metabolic activity.

Viktor Baranov[1,3]*, Jörg Lewandowski[1,3], Paul Romejn[2], Stefan Krause[2]
[1]Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 310, 12587 Berlin, Germany
[2]School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston. Birmingham B15 2TT, UK
[3]Humboldt University of Berlin, Faculty of Mathematics and Natural Sciences, Geography Department, Rudower Chaussee 16, 12489 Berlin, Germany. *Presenting author.

Background

- On of the key processes, regulating carbon sequestering in the lake sediment is environmental respiration.
- It was shown that sediment respiration rate is dependent on several external factors like water temperature, organic matter content, primary production and **bioirrigation**.
- Bioirrigation defines as fluid transport in the sediment matrix, induced by animals activity.

Research questions

- What is the influence of bioirrigation activity (of the **chironomid** larvae) on the sediment respiration?
- Is the density of bioturbators correlates with alteration in sediment respiration?
- Can **resazurin bioreactive tracer** become a new, viable method for measuring environmental respiration in the lakes?

Methods

- Assessment of the oxygen consumption with bioreactive tracer **resazurin (Raz)**.
- Raz is serving as intermediate electron-acceptor in aerobic electron-transport chains. Raz transformation into fluorescent product –**resorufin** (**Rru**) is well correlated with aerobic oxygen consumption in the system (r=0.8-0.986).
- Raz turnover rate (ln(Rru/Raz+1)*Δt) is a good proxy of respiration in the system.

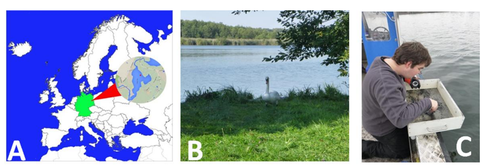


Fig. 1. A) Location of the sediment/larvae collection site; **B**) Collection site; **C**) Sediment sieving.

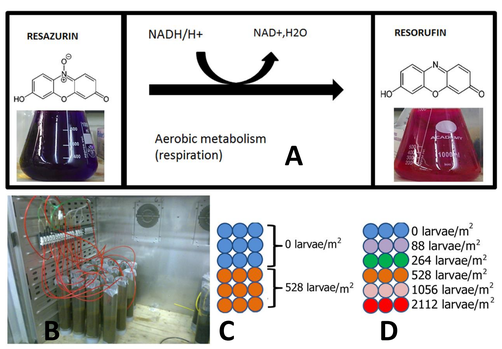
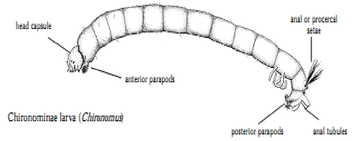


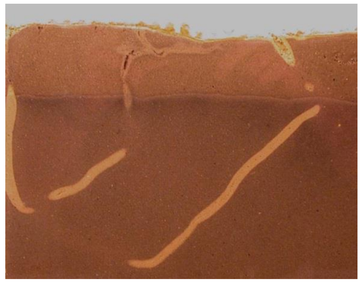
Fig 2. Experimental setup. **A**) Depiction of resazurin (RAZ) – resorufin (RRU) bioreactive tracer system; **B**) General view of the experimental microcosms in the thermostatic chamber; **C**) Two experimental layouts was applied. Experiment I: blue and orange dots represent control microcosms , and experimental microcosms; **D**) Experiment II: each color represents one set of microcosms with a different larvae density.

Organisms used in experiments

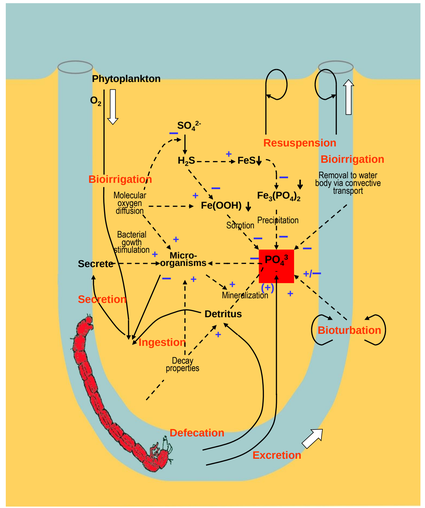


Chironominae larva (*Chironomus*)

Chironomus plumosus L., 1758 (Diptera, Chironomidae) is widespread and abundant bioirrigator, building deep burrows in the sediment and pumping water through the burrow.



Chironomid burrows are changing redox properties of the sediments.



Chironomids has an complex impact on sediment biogeochemistry. They also influencing ecosystems on a lake-wide scale.

Results

- Chironomids prescens has increased sediment respiration up to 2.5 time in comparison with sediment without animals (Fig. 3.).
- Increase of the respiration, Raz turnover rate and Rru accumulation are proportional to the density of animals in the sediment (Figs. 4.A-C).
- Relationships between animals density and respiration increase are not linear, due to **metabolic depression** (**MD**). MD is decreasing organisms activity in the overpopulated sediment(Fig. 4.D).
- Raz reduction is well correlated with respiration of the sediment , but not the animals in the respiration chamber (Figs.5.A,B).

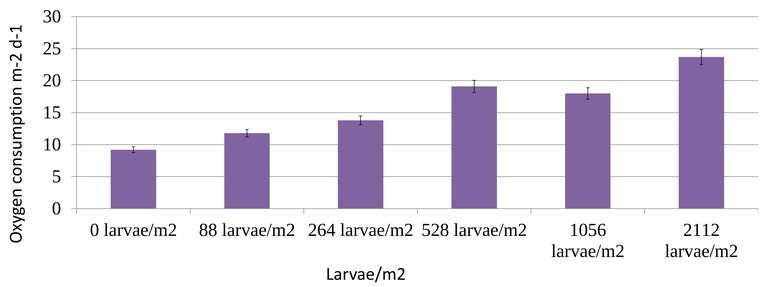


Fig. 3. Oxygen consumption per microcosm calculated based on Raz turnover rate in the different larval density treatments. Consumption O_2 m-2 d-1

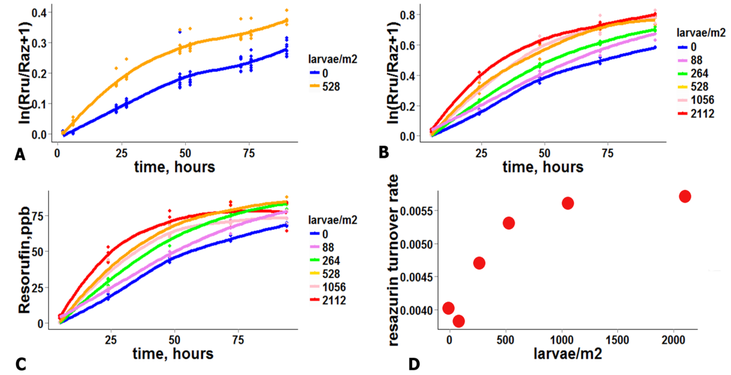


Fig.4. A) Raz turnover rate in Experiment I; **B**) Raz turnover rate in Experiment II; **C**) Rru accumulation over time in Experiment II; **D**) Raz turnover rate as a function of larval density .

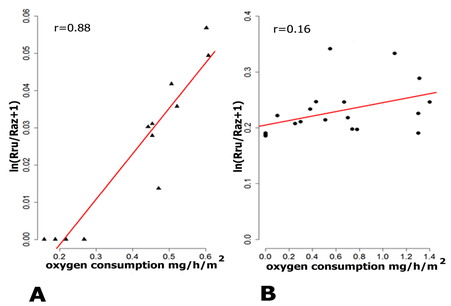


Fig. 5. A) Resazurin consumption and oxygen consumption in defaunated sediment; **B**)Resazurin consumption and oxygen consumption in respiration chamber with larvae.

Conclusions

- Sediment respiration is increasing proportionally to the amount of bioirrigation
- MD is decreasing effects of bioirrigation on respiration of the overpopulated sediment
- Raz is allowing to separate microbial respiration from the respiration of the bioirrigators (chironomids).
- Raz is allowing to measure the sediment respiration in the systems with constant oxygen influx.
- Raz respiration assay is new promising method for environmental respiration measurement

Acknowledgements

This project received funding from the European Union's Seventh Framework Program for research, technological development and demonstration under grant agreement no. 607150 (ITN Interfaces). The authors wish to express their gratitude to Christine Sturm, Grit Siegert, Bibiana Pastor-Menosi, Bernd Schütze and Jörg Friedrich (IGB) for their laboratory support and field sampling assistance.