1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan)

Project title:

Light as a significant factor shaping the structure of pelophilic macrozoobenthos

1.1. Project goals

- Assessment of the impact of changes in the intensity of light reaching the bottom of the water body on the structure of zoobenthos and microphytobenthos, as well as on selected physico-chemical parameters of water and bottom sediments.
- Identification of significant mechanisms of interaction between microphytobenthos and the taxonomic composition and abundance of benthic fauna.
- Determination of correlations between chlorophyll concentration in muddy bottom sediments and selected quantitative parameters (density, biomass) of microphytobenthos.

1.2. Outline

Very little is known about the relationship between light intensity at the bottom and the structure of pelophilic microphytobenthos and benthic fauna in lakes. To date, few studies have been conducted in rivers, where both physico-chemical conditions and biocenosis structure are completely different from those in lakes with muddy bottoms. Therefore, this study can be considered somewhat pilot in nature.

Previous research by the project author has shown that a significant parameter shaping the structure of pelophilic macrozoobenthos in lakes (increase in the number of taxa and density, and changes in dominance structure) is the light reaching the bottom of the water body. Light reaching the bottom enables the development of algae on its surface (microphytobenthos), which alters the living conditions for benthic invertebrates. However, no studies have been conducted regarding the taxonomic composition and abundance of microphytobenthos. Therefore, the main aim of this project is to determine the relationships between light intensity at the bottom of the water body and the structure of microphytobenthos and benthic fauna.

The next stage of the research will be attempt to elucidate the mechanisms regarding the mutual relationships between benthic invertebrates and algae. Is the improvement of food conditions more important in this case (algae as a direct food source for benthic fauna) or oxygenation (oxygen production by algae)? Or perhaps stabilization of the bottom, hindering unfavorable phenomena for macrozoobenthos like sediment resuspension, plays a greater role? It cannot be ruled out that the beneficial effect of microphytobenthos on benthic fauna is a consequence of polysaccharides released by algae into the environment, increasing the abundance and stimulating the metabolic activity of bacteria living in bottom sediments. The issue is extremely important because

both algae and benthic invertebrates have a significant impact on substance exchange between sediments and overlying water. The intensity of this process and the direction of transport (from sediments to water or vice versa) are fundamental for the functioning of the entire ecosystem.

Although not the primary goal, another important aim of this research is to attempt to find correlations between chlorophyll concentration in muddy bottom sediments and microphytobenthos biomass, which would significantly facilitate determining the abundance of algae at the bottom.

The implementation of this project should provide answers to a number of very important questions regarding poorly understood processes related to the influence of light on abiotic conditions and the structure of biocenoses inhabiting muddy lake bottoms.

1.3. Work plan

- Collection and processing of field samples taken from various types of water bodies.
- Detailed analysis, including statistical processing, of the obtained results.
- Laboratory experiments to verify research hypotheses based on the results of field studies.
- Presentation of the results during scientific conferences and preparation of scientific publications after the above-mentioned stages of the research.

1.4. Literature *(max. 10 listed, as a suggestion for a PhD candidate)*

a) Hilt S., Brothers S., Jeppesen E., Veraart A.J., Kosten S. – 2017. Translating regime shifts in shallow lakes into changes in ecosystem functions and services. BioSciences 67: 928-936.

b) Hu Z., Sun Xu., Cai Y., Guo L., Chen Q., Liu T., Shi F., Yang L. – 2016. The habitat type and trophic state determine benthic macroinvertebrate assemblages in lowland shallow lakes in China. J. Limnol. 75(2): 330-339.

c) Moss B. – 1998. Ecology of fresh waters: man and medium, past to future. 3rd ed. Blackwell, 557 pp.

d) Scheffer M. – 1998. Ecology of shallow lakes. Chapman & Hall. 357 pp.

e) Żbikowski J. & Kobak J. – 2007. Factors influencing taxonomic composition and abundance of macrozoobenthos in extralittoral zone of shallow lakes. Hydrobiologia 584: 145-155.

f) Żbikowski J. – 2011. Macrozoobenthos of central parts of shallow lowland lakes of different types against a background of selected abiotic parameters of water and bottom sediments. Habilitation papers, Nicolaus Copernicus University, 232 pp.

1.5. Required initial knowledge and skills of the PhD candidate

- Basic knowledge about the structure and functioning of aquatic ecosystems.
- Skill in sampling and processing benthic macroinvertebrates as well as basic abiotic parameters of water and bottom sediment.
- Critical thinking
- English communication skills (reading, speaking and writing).

1.6. Expected development of the PhD candidate's knowledge and skills

- Planning and conducting scientific research both in the field and in the laboratory.
- Ability to properly interpret obtained results.
- Formulating and verifying scientific hypotheses.
- Presentation of scientific date – publications and conferences.
- Cooperation within the research team, external scientific contacts.