Freshwater food webs under biotic and abiotic stressors

Vliv biotických a abiotických stresorů na sladkovodní potravní řetězce

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

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Annotation

Freshwater ecosystems occupy less than 1% of the Earth's surface but support approximately 10% of global biodiversity, including one-third of all vertebrate species (Strayer & Dudgeon, 2010). The structure of freshwater food webs is characterized by numerous interconnected trophic units (Vander Zanden & Rasmussen, 2001), whose interactions drive the fluxes of energy and matter as well as the stability of these ecosystems (Barrios-O'Neill et al., 2015; Sih et al., 1998). However, these energy flows and the overall stability of freshwater ecosystems are susceptible to a range of biotic and abiotic stressors—including elevated temperatures, eutrophication, biological invasions, pollution, habitat modification—and interactions. These stressors can induce irreversible changes in ecosystem structure and function.

Mentioned stressors can significantly influence both the availability and quality of food resources within aquatic systems (Schälicke et al., 2019). Food quantity refers to the dietary energy (i.e., caloric content) accessible to consumers, whereas food quality refers to its nutritional value, determined by biochemical composition—specifically the compounds essential for physiological processes such as somatic growth, survival, and reproduction (Müller-Navarra et al., 2000). When key nutritional resources are absent and cannot be substitute by alternative sources, individual fitness may decline, potentially leading to changes in population dynamics (Martin-Creuzburg et al., 2008; Schälicke et al., 2019).

Accordingly, a central objective in trophic ecology is to elucidate species interactions and to determine how various food sources are assimilated into consumer biomass. It is also essential to identify which food sources are most critical for sustaining organisms across different trophic levels (Ahlgren et al., 1992; Dalsgaard et al., 2003), and how these trophic relationships are modulated by biotic and abiotic environmental stressors.

The main hypothesis

- Trophic and non-trophic interaction strength in multiple consumer systems will be shaped by stressors and their interaction. But consumer response will depend on their functional group.
- Availability and quality of utilized food sources by consumers might vary due the effect of biotic and abiotic stressors.
- Energy transfer from low levels of trophic chain to higher trophic levels might be modified by given stressors.
- The primary producers quality and biomass might be affected by biotic and abiotic stressors

Aim(s) of the Ph.D. thesis

- To assess differences in energy transfer through food webs between affected and non-affected ecosystems

- To reveal the relationship between multiple consumers and its prey under different biotic and abiotic stressors

Possible approaches to reach the aims / to verify the hypotheses

- Functional response approach in mesocosm with variate consumers and its prey under specific environmental stressors, and their combinations, followed by modelling of future scenarios
- Collecting the data from affected ecosystem (consumer, prey, environmental data) for stable isotopes/ fatty acid analysis.
- Applications of statistical data analysis (GLM, ANOVA, ANCOVA, Bayesian models, predictive models)

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