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

Project title:

"Aerobic scope protection" as a mechanism explaining the higher sensitivity of native predators to elevated temperatures compared to their invasive counterparts

1.1. Project goals

- Verifying the role of the "aerobic scope protection" mechanism in the response of native and invasive fish and invertebrate species to climate warming
- Assessing changes in assemblages of organisms caused by displacement of native species by invasive counterparts on the predator-prey relationship in aquatic ecosystems

1.2. Outline

Biological invasions with ongoing climate warming, pose a significant threats to global biodiversity. Invasive species are generally better adapted to rising temperatures and thus gain a competitive advantage over natives. One of the mechanisms responsible for this may be the lower cost of digestion ("aerobic scope protection") of invasive freshwater species under elevated temperatures compared to their native competitors. The project involves performing a series of experiments to determine the foraging efficiency and growth rate of predators at different water temperatures. In addition, the project will assess the potential energy costs (determine by changes in metabolic rate) suffered by predators consuming various types of prey (including invasive and native species). We assume that the capture and digestion of invasive prey species may be more energetically costly compared to native prey. In addition, we assume that invasive predators have lower foraging costs, which may give them an advantage over native species under elevated temperature conditions.

1.3. Work plan

- Designing experimental setups
- Animal collection in the field
- Conducting experiments in laboratory conditions

1.4. Literature *(max. 7 listed, as a suggestion for a PhD candidate preliminary study)*

- Augustyniak, M., Preiszner, B., Kobak, J., Czeglédi, I., Kakareko, T., Erős, T., Cuthbert, R. N., & Jermacz, Ł. (2025). Global warming affects foraging efficiency of fish by influencing mutual interference. Journal of Animal Ecology. https://doi.org/10.1111/1365-2656.70003

- Błońska, D., Grabowska, J., Kobak, J., Jermacz, Ł., & Bącela-Spychalska, K. (2015). Feeding preferences of an invasive Ponto-Caspian goby for native and non-native gammarid prey. Freshwater Biology, 60(10), 2187–2195. https://doi.org/10.1111/fwb.12647
- Eliason, E. J., & Hardison, E. A. (2024). The impacts of diet on cardiac performance under changing environments. Journal of Experimental Biology (Vol. 227, Issue 20). https://doi.org/10.1242/jeb.247749
- Hardison, E. A., & Eliason, E. J. (2024). Diet effects on ectotherm thermal performance. Biological Reviews, 99(4), 1537–1555. https://doi.org/10.1111/brv.13081
- Jutfelt, F., Norin, T., Åsheim, E. R., Rowsey, L. E., Andreassen, A. H., Morgan, R., Clark, T. D., & Speers-Roesch, B. (2021). 'Aerobic scope protection' reduces ectotherm growth under warming. Functional Ecology, 35(7), 1397–1407. https://doi.org/10.1111/1365-2435.13811
- Skeeles, M. R., & Clark, T. D. (2023). Evidence for energy reallocation, not oxygen limitation, driving the deceleration in growth of adult fish. Journal of Experimental Biology, 226(13). https://doi.org/10.1242/jeb.246012

1.5. Required initial knowledge and skills of the PhD candidate

- Knowledge of issues related to biological invasions
- Knowledge of issues related to the effects of climate change on the functioning of aquatic environments.
- Knowledge of issues related to the measurement of metabolic rates in aquatic species
- Good verbal and written skills in English
- A willingness to learn and a thirst for knowledge
- Experience in experimental research
- Permission to conduct research on aquatic vertebrates

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

Through the implementation of the tasks assigned within the framework of the dissertation, the doctoral student will acquire manual as well as analytical skills to independently plan and conduct experimental research along with the analysis of the obtained results and preparation of the manuscript. In addition, the doctoral student will be prepared for teamwork, taking into account cooperation with researchers from foreign units. One of the tasks expected during the doctoral studies will also be the preparation of an application for research funding from external sources.