

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

Project title: Environmental factors influencing the occurrence of the potentially invasive species, the New Zealand mud snail (*Potamopyrgus antipodarum* Gray, 1843), in different types of aquatic water bodies.

1.1. Project goals

The aim of the research will be to find answers to the following questions:

- a. Which environmental factors significantly influence the occurrence of *P. antipodarum*, including sudden changes in the density of this snail in the same reservoir in successive years?
- b. Does the mass occurrence of *P. antipodarum* in the environment induce changes in the structure of benthic macroinvertebrates?
- c. Are interactions between *P. antipodarum* and parasitic organisms common in the environment, and can they influence the population dynamics of this mollusk?

1.2. Outline

P. antipodarum is an aquatic snail native to New Zealand. It has been introduced to Europe, North America, Australia, Iraq, Turkey and Japan. In several ecosystems it is considered invasive because it becomes highly abundant, impacting the structure and function of the invaded ecosystems.

An important part of the planned research is to identify significant factors influencing the occurrence of this snail in aquatic ecosystems. Most malacological studies are limited to the shallow, nearshore littoral zone, while little is known about what restricts the occurrence of *P. antipodarum* in deeper parts of water bodies. We assume that significant limiting factors may include: 1. low oxygenation of the near-bottom water, 2. the appearance of unstable, heavily hydrated muddy bottom sediments, 3. lack of preferred food. A characteristic feature of the population dynamics of *P. antipodarum* is sudden, drastic (almost to zero) declines in its abundance in the same water body observed in successive years of research. The reasons for this phenomenon are not known. Are these changes in the abiotic environment, or perhaps limitations caused by increased pressure from other organisms, including parasitic ones? Is the decline of *P. antipodarum* preceded by changes in the structure of its population? One of the research goals is to verify the above assumptions (point 1.1.a).

In scientific publications, *P. antipodarum* is often presented as an invasive species. However, according to the project's author, there is a lack of conclusive evidence confirming this claim. Therefore, another aim of the project is to investigate whether the appearance of this snail in various types of aquatic ecosystems (lakes of different trophic states, oxbow lakes, reservoirs) in northern Poland induces negative changes in species richness and density of benthic macroinvertebrates (point 1.1.b).

Interactions of significant ecological importance also include parasitism and the possibility of *P. antipodarum* acquiring trematodes (Trematoda), which use snails as first and second intermediate hosts. *Potamopyrgus antipodarum* is a host for several species

of trematodes with a prevalence of up to 80% in its native range of occurrence. In Europe, cases of parasitism in this snail species are rare, and the causes of this situation require detailed research (point 1.1.c).

Obtaining answers to the above questions will undoubtedly contribute to expanding our knowledge of the biology and ecology of *P. antipodarum*. They will allow us to verify many hypotheses regarding its occurrence and role in the environment, which, in the case of this potentially invasive and widely occurring snail, is extremely important not only for purely scientific reasons but also for practical ones related to the protection of aquatic ecosystems.

1.3. Work plan

- Collection and analysis of field samples (benthic macroinvertebrates with particular emphasis on *P. antipodarum*, as well as selected abiotic and biotic parameters of water and bottom sediments) taken from various types of water bodies.
- Detailed analysis of *P. antipodarum* populations - age structure, preferred food, reproductive intensity, etc.
- Laboratory experiments to verify working hypotheses based on the results of field studies.
- Assessment of the diversity and prevalence of trematode parasites in *P. antipodarum*.
- After the above-mentioned stages of the research presentation of the results during scientific conferences and preparation of scientific publication.

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

- a) Alonso, A., and P. Castro-Diez. 2008. What explains the invading success of the aquatic mud snail *Potamopyrgus antipodarum* (Hydrobiidae, Mollusca)? *Hydrobiologia* 614:107-116.
- b) Cichy A, Marszewska A, Parzonko J, Żbikowski J, Żbikowska dr hab. Janusz Żbikowski E. 2017. Infection of *Potamopyrgus antipodarum* (Gray, 1843) (Gastropoda: Tateidae) by trematodes in Poland, including the first record of aspidogastrid acquisition. *J Invertebr Pathol* 150: 32–34.
- c) Cieplok A., Spyra A., Czerniawski R. – 2023. Globally invasive *Potamopyrgus antipodarum* (Gray, 1843) – an indicator of the degraded water systems in relation to native aquatic invertebrates. *Ecological Indicators* 156: 1-11.
- d) Dussart GBJ (1977) The ecology of *Potamopyrgus jenkinsi* (Smith) in North West England with a note on *Marstoniopsis scholtzi* (Schmidt). *J Moll Stud* 43:208–216
- e) Hechinger RF. 2012. Faunal survey and identification key for the trematodes (Platyhelminthes: Digenea) infecting *Potamopyrgus antipodarum* (Gastropoda: Hydrobiidae) as first intermediate host. *Zootaxa* 3418: 1–27.

- f) Moss B. – 1998. Ecology of fresh waters: man and medium, past to future. 3rd ed. Blackwell, 557 pp.
- g) Żbikowski J, Żbikowska E. 2009. Invaders of an invader-trematodes in *Potamopyrgus antipodarum* in Poland. *J Invertebr Pathol* 101: 67–7

1.5. Required initial knowledge and skills of the PhD candidate

- Basic knowledge about the structure and functioning of aquatic ecosystems.
- Basic knowledge of ecological interactions, including parasitism.
- Skill in sampling and processing benthic macroinvertebrates as well as basic abiotic parameters of water and bottom sediments.
- 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 data – publications and conferences.
- Cooperation within the research team, external scientific contacts.