Our planet undergoes major crisis of biodiversity, with rapid changes in structure and functioning of biological communities. Biological invasions describe introductions of species originating from different geographical areas to new regions. Some of those non-native species starts spreading rapidly and have major impact on the composition of native communities, resulting in one of the major problems for biodiversity and ecosystems. While structure of biological communities naturally evolves over decades, centuries and millennia, the recent increase is unprecedented due to its rapid progress and introductions across large distances. Those changes are challenging for conservation of local species and ecosystems, but they also represent natural experiments which may be studied to understand complex questions in ecology and evolution. Ultimately, biological invasions may help us to learn about the function and resilience of biological communities and inform conservation management plans and strategies.

The biological communities, irrespective of presence of non-native species, are naturally dynamic. Species interact in many ecological relationships, which are ever changing in small incremental steps through the process known as coevolution. Coevolution includes reciprocal changes between two or more interacting species, directly arising from their mutual contacts. Those changes have genetic underpinning, but can be observed at the level of physiology, morphology and behaviour.

Species exist in the form of diffusely connected populations. Each population interacts with a different set of other organisms and in a different environmental setting. Reciprocal adaptations between coevolving organisms therefore arise at small local scales and produce a mosaic of diverse states, sometimes with contrasting outcomes. The most common negative impact of invasive species is by disturbing existing interspecific interactions in native communities. The impact of an invasive species varies dramatically throughout their expanded distribution and evolves following their introduction.

This project seeks to understand how fine-scale variation in interspecific relationships affects the outcome of biological invasions across populations of interacting species and how invasive species evolve during their establishment in local communities.

To study fine-scale coevolutionary dynamics, we will use reciprocal parasitic association between European bitterling fish and invasive freshwater mussels from Far East Asia. Bitterling are small freshwater fish from the carp family. The only European species of the bitterling (*Rhodeus amarus*) parasitizes mussels by laying their eggs in mussel gills. Mussels have complex life cycle with a larval stage (glochidium) which parasitizes fish hosts. European bitterling uses all local mussel species for incubating their eggs and, at the same time, avoids costs associated with hosting their larvae. In East Asia, bitterling and mussel diversity is greatest, and their mutual relationship is stronger and more complex. Over the last 50 years, Chinese pond mussel (*Sinanodonta woodiana*), has been introduced across Poland, with a quick increase in new invasive populations in the last 15 years. We have already shown that different populations of the Chinese pond mussel have an unequal impact on European bitterling, including complete reversal of the roles of host and the parasite.

We will use several bitterling and Chinese pond mussel populations to study whether rapid evolutionary change in the bitterling, resulting from coexistence with Chinese pond mussel, leads to a decrease in negative impacts of the invasive mussel on bitterling populations.

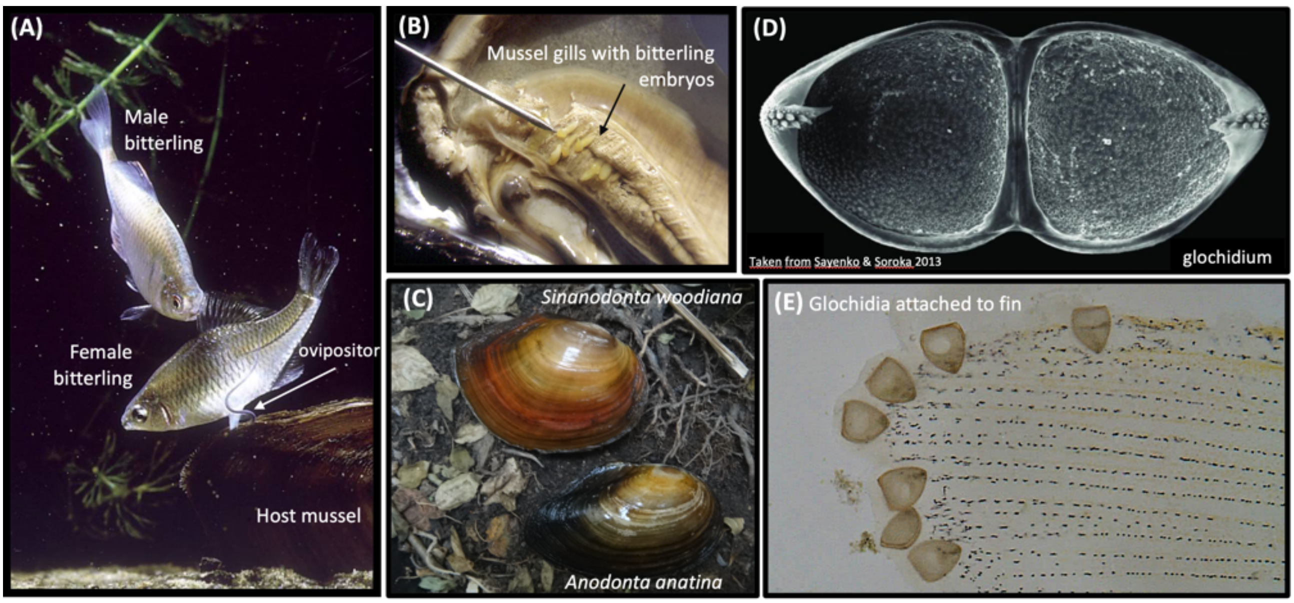

Fig. 1. (A) Bitterling pair ovipositing in a host mussel, (B) 5 days old bitterling embryos in mussel gills, (C) two study mussel species, invasive *S. woodiana* and native *A. anatina*, (D) glochidium (parasitic larval stage) of *S. woodiana* (shell size 200-300 μm) and (E) *S. woodiana* glochidia attached to bitterling caudal fin.