Nowadays, one of the most concerning emerging contaminants are pharmaceutically active compounds (PhACs) – the core ingredients in medicines responsible for their therapeutic effect. These compounds are ubiquitous aquatic environmental contaminants found not only in Europe but also in many other parts of the world. The main source of PhACs in water bodies is inadequately treated wastewater. Studies have shown that the effectiveness of wastewater treatment plants in removing PhACs depends on the treatment technology used and the chemical structure of the treated compound. Unfortunately, in most cases, treatment processes are inefficient at removing PhACs completely. As a result, PhACs are discharged into surface waters along with the treated effluents, where they become adsorbed onto sediments. PhACs adsorbed to sediments can later dissolve back in the water column, making sediments a continuous source of contamination. Moreover, when sediment is disturbed and re-suspended, the adsorbed PhACs can be carried by water currents to remote pristine areas. This poses a potential risk to ecosystems far from the original source of contamination.

Currently, it is difficult to estimate the risk posed by PhACs found in sediments towards wildlife. This is because we do not have enough information about what happens to PhACs in the environment and how they affect sediment-dwelling organisms living in bottom sediments. Our preliminary studies have shown that the risks related to PhACs found in sediments of the Odra River estuary, calculated according to international guidelines, are inaccurate. Similar inaccurate results can also be expected for other locations in the world. Therefore, new knowledge is needed to more accurately estimate the risks posed by the presence of PhACs in the environment.

To accurately assess the risk of PhACs in sediments, we need data on how a particular PhAC affects benthic organisms inhabiting the bottom of water bodies. In our project, apart from performing standard toxicity tests, we will also develop and apply more sensitive and accurate advanced approaches to assess environmental risks. These new methods are able to detect the potential toxic effects of PhACs on living organisms at the molecular level including changes in proteome and metabolome, as well as the occurrence of oxidative stress. It is expected that changes in both specific metabolic pathways and oxidative stress markers will be observed before morphological or functional changes in the behaviour and/or reproduction of organisms occur. In the project, we will also employ an innovative approach based on molecular imaging, which will allow us to trace the fate of PhACs in the crustacean organism and confirm the changes observed in metabolomic pathways. We will also use computational techniques (molecular docking) to elucidate the mechanism of the processes responsible for the observed changes. Our planet is facing many challenges, including pollution from substances like PhACs and climate change. Therefore, in this project, we will also explore if global warming can exacerbate the harmful effects of PhACs on aquatic organisms.

In our project, we will select ten PhACs based on their concentrations in river sediments from the Vistula River and the Oder Estuary, and assess their potential harmful effects As PhACs concentrations are often higher at the water-sediment interface, we will use two types of sediment-dwelling organisms, crustaceans *Heterocypris incongruens* and *Gammarus* sp., as our test organisms. Such benthic crustaceans are exposed to PhACs not only through a direct contact with contaminated water and sediments but also via the oral route with food, benthic microorganisms and detritus.

The findings of our project will expand the knowledge on the environmental effects of PhACs and will allow us to more accurately assess the environmental risks posed by PhACs in sediments. Our results will also contribute to the development of environmental metabolomics, a relatively young field of omics sciences. In the long term, they may support discussions on implementing necessary changes in wastewater treatment systems leading to more effective removal of PhACs, thus preventing them from entering the environment.