Protecting biodiversity in aquatic ecosystems is one of the most significant challenges of the 21st century. An increasingly widespread problem is the presence of pharmaceuticals in surface and groundwater. Pharmaceuticals, a group of bioactive compounds used in therapeutics, are not fully metabolized, and their excretion in unchanged form results in their entry and presence in the environment, where they can cause adverse effects. Traditional methods of removing these contaminants frequently prove inadequate and expensive, so new, effective, and sustainable solutions are being sought.

Recently, nanozymes, synthetic molecules that mimic the action of natural biocatalysts, have been gaining popularity. Thanks to their biocompatibility and high stability, they represent a novel technological solution that could revolutionize environmental clean-up processes, eliminating the need for toxic solvents. Their ability to effectively degrade micropollutants while minimizing negative impacts on aquatic ecosystems makes them a key component of future sustainable environmental technologies. Nanozymes are also characterized by greater resistance to changes in pH and temperature, making them even more versatile and sustainable biocatalysts compared to their natural counterparts.

The project's research will aim to develop new methods for the synthesis of metallic, oxide nanozymes or metal-organic structures (MOFs) that exhibit high stability under varying environmental conditions. The synthesis of these systems will be optimized for various parameters such as pH, temperature, reactant concentration, and reaction time to obtain materials with the best catalytic properties and stability. It is also assumed that the addition of suitable ligands will increase their selectivity and catalytic activity. These ligands will be precisely selected and tested to maximize the efficiency of the nanozymes under different conditions. One of the key applications of the systems under development will be removal of pharmaceuticals from both model and real aqueous solutions. Planned tests will be conducted in bioreactors, to evaluate the efficiency and stability of the nanozymes and develop technological concepts for larger-scale implementation.

The use of nanozymes as biocatalysts also has potential economic benefits. **This is because synthetic biocatalysts can be reused, leading to lower operating costs. In addition, the effective removal of harmful pharmaceutical compounds from water can significantly improve water quality and will undoubtedly have a positive impact on the environment, offering an innovative and economically viable solution to the problem of water pollution.** It is also worth noting that the use of nanozymes in this way has not been widely reported in the scientific literature to date. The data collected during the project can significantly enrich the current knowledge on nanozymes, opening up new opportunities for research and applications. The project will not only contribute to scientific progress but can also have a real impact on environmental protection and improving the quality of life.