Many essential biological processes and activities of living organisms, such as eating, sleeping, hormone production or body temperature show regular daily changes. This rhythms are driven by biological/circadian clocks and enable organisms to anticipate changes in the environment and adapts physiology to the different phases of the day and season. The molecular basis for the proper functioning of the clock are clock genes and their proteins, which work in complex interactions. In animals, the master circadian clock is physically located in, an evolutionarily ancient parts of the brain, the suprachiasmatic nucleus in the hypothalamus. There are also other secondary or peripheral biological clocks throughout the body, such as in the liver, heart, kidneys, and even in the skin, daily oscillations. Such peripheral clocks were also found in mammalian immune system, a key system for organism protection from pathogens e.g. bacteria and viruses. Moreover, there are strong evidences that the disruption of circadian rhythms negatively affects the immune response, which in turn may lead to autoimmunity or cancer.

The importance of this problem is growing due to the increasingly intensifying phenomenon of light pollution, which is associated with the occurrence of artificial lighting at night. This leads to dysregulation of the biological clock mechanism and disruption of natural circadian and circannual timing. The phenomenon of light pollution also affects the functioning of the immune response.

Therefore, it seems extremely important to better understand the regulation of the immune system by biological clock.

A specially intriguing model for these studies form fish. They are found in essentially every aquatic habitat and have been successful in adapting to different environments and most probably their ability to control and co-ordinate immune responses to environmental challenges must have contributed to this success. Moreover, fish are first animals which possess fully developed immune system.

The main innovative approach of the present proposal therefore concerns identification of evolutionary old/conserved mechanisms that underlie the clock-immune crosstalk.

The basis of the planned research is the assumption that the fish immune system is regulated by signals from the biological clocks. In order to verify the hypothesis we will carry out the following tasks: i) identification of clock genes and proteins in the immune system of carp and zebrafish and examination whether their expression is regulated by light and changes during infection, ii) observation of the rhythm of immune response as the effectiveness of the immune response and fish survival in various lighting conditions and finally iii) explaining which particular components of the clock are crucial for the rhythm of the immune system.

This project will allow to identify the evolutionary conserved mechanisms of immune and neuroendocrine cooperation which are of pivotal importance. Our scientific achievements will contribute to a fundamentally better understanding of the mechanisms of protective immune responses in fish. Moreover, we trust, that it will allow to develop specific new techniques to efficiently and accurately determine the status of animals combatting increasing light pollution and will moreover provide essential knowledge to improve aquaculture practice and prevent negative effects of the circadian rhythm disruption in fish and in the future other vertebrates including human beings.