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An epidemic model for the interactions between thermal regime of rivers and transmission of Proliferative Kidney Disease in salmonid fish

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Proliferative kidney disease (PKD) affects salmonid populations in European and North-American rivers. It is caused by the endoparasitic myxozoan *Tetracapsuloides bryosalmonae*, which exploits freshwater bryozoans (*Fredericella sultana*) and salmonids as primary and secondary hosts, respectively. Incidence and mortality, which can reach up to 90-100%, are known to be strongly related to water temperature. PKD has been present in brown trout population for a long time but has recently increased rapidly in incidence and severity causing a decline in fish catches in many countries. In addition, environmental changes are feared to cause PKD outbreaks at higher latitude and altitude regions as warmer temperatures promote disease development. This calls for a better comprehension of the interactions between disease dynamics and the thermal regime of rivers, in order to possibly devise strategies for disease management.

In this perspective, a spatially explicit model of PKD epidemiology in riverine host metacommunities is proposed. The model aims at summarizing the knowledge on the modes of transmission of the disease and the life-cycle of the parasite, making the connection between temperature and epidemiological parameters explicit. The model accounts for both local population and disease dynamics of bryozoans and fish and hydrodynamic dispersion of the parasite spores and hosts along the river network. The model is time-hybrid, coupling inter-seasonal and intra-seasonal dynamics, the former being described in a continuous time domain, the latter seen as time steps of a discrete time domain. In order to test the model, a case study is conducted in river Wigger (Cantons of Aargau and Lucerne, Switzerland), where data about water temperature, brown trout and bryozoan populations and PKD prevalence are being collected.