Koi Herpesvirus Disease as a Model of Environmental Disease

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Abstract

Koi herpesvirus disease (KHVD) is first recognized in 1990's, and its pathogen is *Cyprinid herpesvirus 3* (CyHV-3: also known as koi herpesvirus or KHV). This highly contagious and virulent disease is a significant threat for common and koi carp farms and for freshwater ecosystems. Our research project "Effects of Environmental Change on Interactions between Pathogens and Humans" aim to examine the hypothesis that human alteration of environments could facilitate the emergence and spread of infectious diseases using KHVD as a model disease. Here, I present a part of our results on interaction between human impact and the ecology of CyHV-3 and carp. At first, the results of a nationwide survey of all national class-A rivers and 4-years monitoring in a natural lake (Lake Biwa, Japan) and river (Yura River, Japan) will be presented. Almost all rivers in Japan are contaminated with CyHV-3, although only 5 years have passed since its initial detection. The results indicate that virus invasion does not consistently cause an outbreak and that several environmental factors may be involved in its occurrence. Next, the hot spot of KHVD infection was investigated, and the results indicate that breeding habitats can become hot spots for transmission of KHVD. The result of numerical model study indicated that the decrease of breeding habitats by human activity may enlarge the size of outbreak. Finally the possible story of KHVD spread, which starts from the environmental alteration by humans, was investigated by the combination of field observations and laboratory experiments. The results showed that the lake-shore reinforcement could force the temperature stress to wild animals via a loss of spatiotemporal heterogeneity of water temperature, and that the stress promote the appearance of the disease. From these studies, we can conclude that KHVD is a suitable model for the environmental disease.

Keywords: Environmental alteration; *Cyprinid herpesvirus 3* (CyHV-3); disease outbreak; Koi herpesvirus disease (KHVD); temperature stress