

Title

The ABCs of liver fluke: Predicting the effectiveness of Augmented Biological Control against the liver fluke using an agent-based model.

Abstract

Trematode infections are a persistent problem for public and animal health, leading to serious economic and welfare issues. The liver fluke, *Fasciola hepatica*, is a trematode of global significance, due to its important economic and welfare impacts on livestock, and as an infection risk to 180 million people. Liver fluke infections cost the livestock trade an estimated three billion dollars per year, due to reduced meat and dairy yields, animal loss and treatment costs. The main treatments against *F. hepatica* are chemotherapeutics used to target the adult and juvenile fluke within the definitive host. In the past, these anthelmintics have proven highly efficacious, however, due to the over reliance on anthelmintics globally, the liver fluke has developed resistance, rendering the effective removal of this parasite increasingly difficult. Additional or alternative control is, therefore, needed for continued effective fluke control. Augmented biocontrol, alone or as an addition to chemotherapeutic treatment is one such alternative. Microinvertebrates are abundant in habitats where the parasites' intermediate host snail (*Galba truncatula*) resides, and our empirical work has shown these microinvertebrates consume the miracidia of *F. hepatica*. Here, we use an agent-based modelling approach to predict the efficacy of applying additional microinvertebrates within the habitat of the intermediate host, as a biological control, with and without the addition of chemotherapeutics control in the definitive host. We explore the efficacy of these different strategies, in reducing the number of liver fluke infections alongside various anthelmintic resistance scenarios. With the political goal of improving environmental

practices and biodiversity within agricultural settings, providing a natural control method may create a win-win scenario that benefits the environment and reduces the burden of liver fluke.