PhD Project Advertisement

Project title: Combining molecular biology and computer modelling to enhance control of liver fluke in livestock across agricultural landscapes
Project No: FBS2022-37-Jones-aq
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Project description:

Liver fluke (*Fasciola hepatica*) is a highly pathogenic trematode parasite that is highly prevalent in cattle and sheep globally, with its disease, fasciolosis estimated to cost European livestock producers over £2 billion annually. Climate change and anthelmintic resistance are driving increasing liver fluke prevalence globally. This increase in prevalence is seriously impacting animal health, welfare and productivity, and threatening the sustainability of livestock production in certain regions.

To alleviate this threat, and to sustainably manage liver fluke in future decades, alternative non-chemical control strategies are required. These alternative strategies may target the *F. hepatica* lifecycle, which revolves around an intermediate snail host (*Galba truncatula*). This snail is only present in areas on pastureland where optimal environmental and microclimatic conditions allow it to thrive. Strategies including grazing rotation, temporary or permanent fencing of risk areas and targeted treatment of livestock to reduce pasture contamination of *F. hepatica* eggs can impede the lifecycle. However, major barriers prevent the mass adoption of these alternative control strategies. Poor understanding of the spatial distribution *G. truncatula* habitats on farms impedes on the ability of farmers to successfully apply measures targeting the snail. There is also limited information regarding how these alternative strategies can be optimally applied, including which periods of the year they should be employed and for how long.

In recent years, the project's supervisory team have developed novel research tools that allow researchers to investigate the epidemiology of *G. truncatula* and *F. hepatica* at field level. These include the development of environmental DNA assays which can identify the presence of *G. truncatula* on farmland (Jones et al., 2018), and mechanistic modelling techniques which can accurately model *F. hepatica* infection risk over time at farm level (Beltrame et al., 2018). This project aims to utilise these tools to develop and evaluate farm specific guidance for successful application of non-chemical control methods for *F. hepatica* control on UK farms.

During the PhD programme, the prospective student will evaluate and compare a range of DNA extraction methods and molecular tools to identify optimal methodology for *G. truncatula* eDNA capture, extraction and amplification. The optimal methodologies identified will then be applied to survey *G. truncatula* habitats on multiple UK farms. Environmental and climatic measurements will also be gathered in these sampling sites and analysed in conjunction with eDNA survey results to identify factors associated with the presence of *G. truncatula* snails in water-saturated habitats on farmland. Finally, mechanistic models will evaluate the impact of grazing rotations, temporary and permanent fencing of *G. truncatula* habitats and targeted treatment to minimise pasture contamination of fluke eggs on future *F. hepatica* infection risk in grazing livestock on farms studied and mapped via eDNA survey. These models will also evaluate the optimal timeframe for the application of these strategies, how weather interacts with farm topography and structure to affect their success,

and how pasture architecture can be altered to enhance impact of grazing-based control, for fluke and co-infecting nematode parasites.

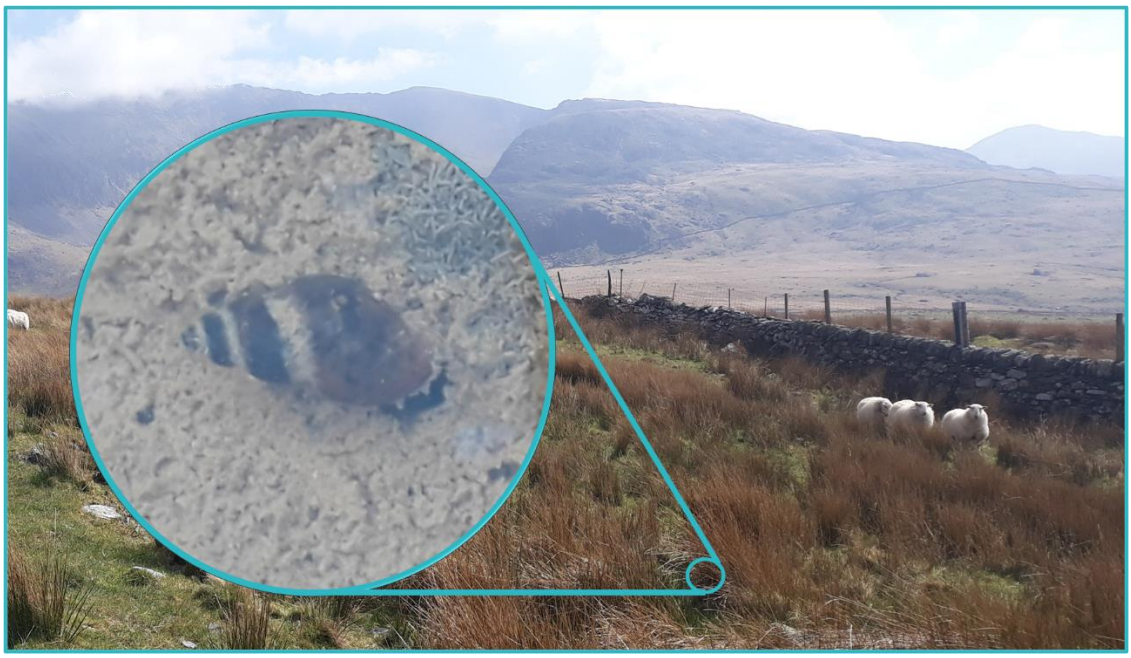

Figure 1: The mud snail (*G. truncatula*) is the main intermediate host snail of *F. hepatica*, yet only resides in specific areas on pastureland where environmental and climatic conditions are optimal. The project aims to use tools to identify these areas and apply modelling to develop optimal grazing strategies to mitigate *F. hepatica* infection risk.

Training opportunities:

The prospective student will acquire inter-disciplinary skills in molecular biology, parasitology, computational modelling and generic research methods and communication. Specifically, the prospective student will develop skills to perform a range of DNA extraction and amplification methodologies, to morphologically identify intermediate snail host and parasite life stages and to develop and apply mechanistic models. Training will be provided by the supervisory team and by Aberystwyth University's Graduate School Doctoral Training Programme. The prospective student will also have access to funds to support attendance of national and international conferences.

Student profile:

The project would suit a student with a keen interest in sustainable livestock production and parasitology. Applicants will require a BSc honours degree (or equivalent), in biology, parasitology, agriculture, veterinary, animal science or a closely related subject. Experience and training in parasitology, molecular biology and computational modelling will be highly advantageous, but not essential as extensive training will be provided.

References:

Beltrame, L., Dunne, T., Vineer, H.R., Walker, J.G., Morgan, E.R., Vickerman, P., McCann, C.M., Williams, D.J. and Wagener, T., 2018. A mechanistic hydro-epidemiological model of liver fluke risk. Journal of the Royal Society Interface, 15(145), p.20180072.

Jones, R.A., Brophy, P.M., Davis, C.N., Davies, T.E., Emberson, H., Stevens, P.R. and Williams, H.W., 2018. Detection of Galba truncatula, Fasciola hepatica and Calicophoron daubneyi environmental DNA within water sources on pasture land, a future tool for fluke control?. Parasites & vectors, 11(1), pp.1-9.

For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.