**One man’s meat is another man’s poison: exploring the effect of mass drug administration against schistosomes on the aquatic food web.**

**Lead Supervisor Name**

Dr Joanne Lello

**Lead Supervisor Contact Details**

lelloj@cardiff.ac.uk

**Lead Supervisor Location/Student Home Institution**

Institution: Cardiff

School: School of Biosciences

**Full Project Description**

Parasites are an integral but under-recognised component of ecosystems. In particular, within food webs they can alter chain length and connectance and, because they act across trophic levels, they can increase web stability. In aquatic food webs the parasitic trematodes are a particularly important group, with aquatic molluscs, commonly acting as their intermediate hosts. Within these molluscan hosts the asexual reproductive phase of the parasites’ life cycle occurs, characterised by a rapid and substantial increase in parasite biomass, as the definitive host infective stages are produced. These trematodes are therefore important, because of the substantial effects they have upon their host molluscs, which are themselves an important link between the primary producers and the higher trophic levels, and because of the substantial output of infective stages from the molluscs. These infective stages form a significant component of the zooplankton, an essential food source for juvenile fish and other higher organisms. Interestingly, the parasites can also affect one another, as different species can compete for resources inside coinfected molluscan hosts, so that any change in abundance of one parasite species can have ripple effects upon its competitors. Among the trematodes, the Schistosomatidae are a significant family (>100 species), within which the genus Schistosoma is notable, as it is species from this genus that are a serious threat to human health in Low to Middle Income Countries (LMIC), with >220 million people infected each year. Due to the health and economic importance of this genus, mass drug administration is frequently used to control parasites. Such mass drug administration programmes stop, or very substantially reduce, the output of mollusc infective stages into the aquatic environment. The unexplored consequences of these substantial and repeated parasite perturbations, upon aquatic food web structure and / or function, will be the focus of this PhD. Specifically, we aim to determine:

1. What role schistosomes play in the aquatic food web of Lake Victoria.
2. To what extent mass drug administration of humans alters the food web structure and trophic dynamics.
3. How long-lasting any perturbations are within the food web.
4. Whether we can leverage this new understanding of parasites in food web ecology to improve aquatic ecosystem health, including decreasing schistosome transmission.

The successful applicant will undertake fieldwork in and around Lake Victoria in Uganda. Of the human population living along the shores of the lake, 59% of adults and 50% of children are infected with schistosomes. This extremely heavy burden of infection suggests a substantial input of freshwater snail infective stages (the molluscan intermediate host for human schistosomes), is passing into the aquatic ecosystem. Such high levels of human infection have led to a parasite control programme that chiefly involves mass drug administration in the human population, administered at 6 monthly intervals. External supervisor Prof Stothard of LSTM, has worked in these communities for many years and has ongoing collaborations with current biomedical researchers in the area, with whom the student will be based during field seasons.

The prospective student, in addition to the extensive FRESH training programme, will also receive inter-disciplinary training, including:

1. field skills in aquatic food web analysis, e.g. sampling techniques, sample processing, species identification
2. parasitology, including visual and molecular identification and enumeration of parasites from both snails and humans
3. network analysis
4. advanced statistical modelling. This project provides an exciting opportunity to integrate fundamental ecology with applied biomedical research, with the ultimate aim of building a stronger and healthier aquatic ecosystem
5. public engagement skills training

\* DEFINITIONS: i) Chain Length - number of links between a trophic consumer and the lowest trophic level of the food web ii) Connectance - the proportion of all possible links that are realised in a food web RECOMMENDED READING: • Lafferty K D, et al., 2006. PNAS, 103(30), pp.11211-11216. • Johnson P T, et al., 2010. TREE, 25(6), pp.362-371. • Thieltges D W, et al., 2013. Oikos, 122(10), pp.1473-1482. • Lafferty K D, et al., 2008. Ecology Letters, 11(6), pp.533-546.

**Real Life challenges this project will address**

Loss of diversity is a major threat to ecosystem stability. Deliberate removal of parasites represents a direct loss of diversity but, moreover, may lead to other species losses or imbalances due to the disruption to the food web caused by their removal.

**What you should know about this project**

Parasites are essential components of aquatic food webs, acting as both consumers and prey and increasing stability. By combining the supervisory expertise of parasitologists and an expert on food webs structure and function, we will, together with the student, explore how mass drug administration against parasites alters an aquatic food web.

**What expertise you will develop**

The student will develop skills in:

* Food web analysis – animal sampling and habitat analysis, ecological network analysis and construction of food web models.
* Parasite biology – particularly, collection and the morphological and molecular identification of different schistosome species and their snail vectors.
* Ecological data analysis and statistics – including generalised mixed modelling and path analyses

**Why this project is novel**

Mass drug administration programmes are commonly used to control human and animal parasites. Yet, despite the importance of parasites in aquatic food webs, the downstream effects of this common and regular pattern of parasite removal, upon the structure and stability of food webs, has never before been explored.

**Rest of Supervisory Team:**

**Stakeholder Organisation** Natural History Museum - London

**Stakeholder Supervisor** Bonnie Webster

**Co-Supervisor 1** Dr Frank Van Veen

Affiliation: Exeter

Email: F.J.F.Van-Veen@exeter.ac.uk

**Co-Supervisor 2** Professor Russell Stothard

Affiliation: Liverpool School of Tropical Medicine

Email: R.Stothard@liverpool.ac.uk

**Co-Supervisor 3** Dr Aidan Emery

Affiliation: Natural History Museum

Email: a.emery@nhm.ac.uk