CEH PhD Studentship 2013

Modelling the phenological effects of multiple environmental drivers on mosquito populations. What is needed for the mosquito perfect storm?

Project Outline:

Understanding how environmental drivers alter mosquito temporal abundance in a way that is likely to cause outbreaks of mosquito-borne zoonotic disease (MBZD – e.g. West Nile virus) is central to predicting and managing such diseases. Environmental drivers (such as rainfall, temperature, evaporation, competition and predation) alter development, fecundity, survival and therefore abundance of mosquitoes. This has direct effects on pathogen transmission rates but perhaps the most subtle and profound effects derive from species phenology. Since it is the temporal pattern of female-blood feeding mosquito abundance in relation to the availability of susceptible hosts that governs whether a MBZD exhibits high-prevalence sustained transmission in wildlife, and therefore potential for disease spill-over to man and domestic animals. Furthermore, the timing and magnitude of multiple environmental drivers could combine to provide the perfect storm, causing mosquito dynamic abundance capable of sustaining MBZD.

The aim of this project is to investigate the role of environmental drivers in mosquito populations. The student will develop and analyse a system of state-dependent delayed differential equations in which environmental drivers affect life-history parameters and development lags focusing on the mosquito species Culex pipiens the key maintenance vector of many MBZDs including West Nile virus. The model will be analysed by extensive numerical simulation techniques using a suitable programming language. In addition, the student will collect and maintain field caught populations of Culex pipiens mosquitoes in the UK and undertake empirical studies to parameterise the models. Finally, the student will spatially extend the model using remotely sensed and large scale datasets to produce realistic, spatially explicit risk maps of UK mosquito outbreaks.

The successful candidate will have a strong background in mathematics, statistics, theoretical physics or theoretical ecology. In addition, the candidate will have demonstrated substantial knowledge of numerical analysis techniques for solving differential equations in a suitable scientific programming language (e.g. Fortran, Matlab etc). Training will be given in mosquito laboratory and field work. A demonstrated interest in population ecology, population modelling and/or vector-borne disease ecology is desirable.

This project will be based at the Centre for Ecology & Hydrology (CEH) Wallingford in Oxfordshire, UK under the supervision of Dr Steven White and will be co-supervised by Dr Christina Cobbold (School of Mathematics and Statistics, University of Glasgow), Dr Miles Nunn (CEH Wallingford) and Dr Beth Purse (CEH Edinburgh).

Funding Notes:

To apply for this project please send a CV and covering letter with details of two referees to the contact supervisor. The deadline for applications is 31st January 2013.

CEH are committed to a high quality graduate training programme to ensure that the successful candidate has access to opportunities to develop their career skills and experience. For eligible students a stipend and fees will be provided at the RCUK rate. Please refer to the CEH website at www.ceh.ac.uk for details of our scientific research and to the NERC website at http://www.nerc.ac.uk/funding/available/postgrad/ for details of funding eligibility.

References:

1. *Gurney, W. S. C., et al. "The systematic formulation of tractable single-species population models incorporating age structure." J. Anim. Ecol. (1983): 479-495.*
2. *White, S. M., et al. "Modelling pulsed releases for sterile insect techniques: fitness costs of sterile and transgenic males and the effects on mosquito dynamics." J. Appl. Ecol. 47.6 (2010): 1329-1339.*
3. *Searle, K. R., et al. "Identifying environmental drivers of insect phenology across space and time: Culicoides in Scotland as a case study." Bull. Entomol. Res. 1.1 (2012): 1-16.*
4. *Golding, N., et al. "West Nile virus vector Culex modestus established in southern England." Parasit Vectors 5 (2012): 32.*
5. *Purse, B. V., et al. "Impacts of climate, host and landscape factors on Culicoides species in Scotland." Med. Vet. Entomol. (2012).*

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Further Information:
http://www.findaphd.com/search/ProjectDetails.aspx?PJID=41928&LID=1110