MATHEMATICS OF MOSQUITOS AND OTHER INSECTS: THE ROLE OF TRAIT VARIATION

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Climate change is having profound effects on the incidence of vector borne disease, such as dengue, chikungunya and West Nile virus. However, developing effective measures of disease risk on a global scale are challenged by the complex ways in which environmental variation acts in vector-host-pathogen systems. One way in which insect vectors, such as mosquitos, respond to environmental variation is to change their traits. For example, if food was scarce for juvenile mosquitos then when they become adults they are smaller, and lay fewer eggs to ensure there is less competition for food in the next generation. So the environment of the juvenile determines the trait the individual has as an adult. In this way the individuals adapt to the environment. Current models over-simplify the interaction between vector traits and environmental variation and so risk misestimating disease risk. Here, we derive a mathematical framework for capturing the interaction of vector traits and population dynamics. I show how this new mathematical framework leads to both interesting mathematical questions and can be used to help explain the location, magnitude and timing of historical dengue outbreaks.