Variable vectors and expanding epidemics: how ecology across scales influences parasite strategies within the host

Megan A. Greischar[1] **Lindsay M. Beck-Johnson**[2] **Nicole Mideo**[1]

[1] *Department of Ecology & Evolutionary Biology*
University of Toronto
Toronto, ON, M5S 3B2 Canada

megan.greischar@utoronto.ca
nicole.mideo@utoronto.ca

[2] *Department of Biology Colorado State University 1878 Campus Delivery Fort Collins, CO 80523*

L.Beck-Johnson@colostate.edu

Vector-borne parasites must succeed at three scales to persist: proliferating within the host, establishing in vectors, and transmitting back to hosts. Ecology outside the host undergoes dramatic seasonal and human-induced changes, but predicting parasite evolutionary responses to such changes requires integrating parasite success across scales. We develop a data-driven model of human malaria infections to examine the evolution of a within-host trait—how parasites allocate host resources to within-host proliferation versus onward transmission—that influences disease severity and transmission success. We find that allocation to transmission controls the timing of host infectiousness over the course of infection: A trade-off emerges between early and late infectiousness, and the optimal resolution of that trade-off depends on ecology outside the host. The expansion of a human epidemic selects strongly for early infectiousness, overwhelming the impact of host recovery rates and mosquito population dynamics. However, predicting evolutionary outcomes in response to changing ecology requires understanding any association between parasite allocation and host recovery, presently unknown. Our study shows that ecology outside the host can have a dramatic influence on the evolution of parasite traits expressed within a host, with the potential to alter both disease severity and spread.

⋆Mini-Symposium: Immuno-epidemiological models