A Spatial Model of Mosquito Host-Seeking Behavior

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Mosquito host-seeking behavior and heterogeneity in host distribution are important factors in predicting the transmission dynamics of mosquito-borne infections such as dengue fever and malaria. We develop and analyze a new mathematical model to describe the effect of spatial heterogeneity on the contact rate between mosquito vectors and hosts. The model includes odor plumes generated by spatially distributed hosts, wind velocity, and mosquito behavior based on both the prevailing wind and the odor plume. We compare the effectiveness of different plume-finding and plume-tracking strategies that mosquitoes could use to locate a host. The results show that host finding is optimized by a strategy of flying across the wind until the odor plume is intercepted. When clusters of hosts are more tightly associated on smaller patches, the odor plume is narrower and the biting rate per host is decreased. For two host groups of unequal number but equal spatial density, the biting rate per host is lower in the group with more individuals, indicative of an attack abatement effect of host aggregation.

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