13th North American Forest Ecology Workshop (NAFEW)
20-24 June 2022, online/virtual

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Preference: Oral presentation
Theme: Insect Disturbances
Status: Postdoctoral Researcher

Differences in weather-driven dispersal patterns between spruce budworm males and females and their potential effects on nearby populations

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Abstract: In recent work exploring the weather-driven dispersal of adult spruce budworms (SBW: Choristoneura fumiferana Clemens) during the current outbreak in eastern North American boreal and sub-boreal forests, we described an individual-based numerical model of that process and demonstrated that SBW males and females exhibited different patterns of dispersal in simulations of two flight events in July 2013 (Garcia et al., 2022). Those differences arose from physiological variations between SBW males, who are generally smaller and carry less mass, and females who carry greater mass due to egg loads through much of their adulthood. Combined with the temperature-driven aspects of SBW flight physiology, these differences led to generally higher and longer flights for males and generally earlier, lower, and shorter flights for females. The SBW males and females thus carry on their contributions to SBW reproduction, either by alleviating mating failure in existing populations or by oviposition, respectively, in different locations. Here we review our modeling results and analyses, including variability in estimated landing locations. We then extend that work to estimate potential effects on the development and spread of an SBW outbreak to new locations using a highly simplified, but spatially explicit, model of SBW population dynamics including dispersal events. Idealized simulations demonstrate the effects of male immigrants on the existing SBW population in some locations and the effects of egg-laying female immigrants in others where SBW may or may not already exist. We discuss conclusions regarding the roles of sex differences in dispersal during an SBW outbreak, especially the varied contributions of that process to overcoming Allee effects (mating failure) and the establishment of new population hotspots, and their effects on an outbreak's regional trajectory (population densities and areal coverage) over space and time.

Reference: Garcia et al., 2022: https://doi.org/10.1016/j.agrformet.2022.108815