USING A CELLULAR MODEL TO EXPLORE HUMAN-FACILITATED SPREAD OF RISK OF EAB IN MINNESOTA

Anantha Prasad[1], Louis Iverson[1]
Matthew Peters[1], and Steve Matthews[1,2]

[1]Northern Research Station, USDA Forest Service, Delaware, OH
aprasad@fs.fed.us

[2]School of Natural Resources, The Ohio State University, Columbus, OH

ABSTRACT

Introduction: The Emerald Ash Borer has made inroads to Minnesota in the past two years, killing ash trees. We use our spatially explicit cell based model called EAB-SHIFT to calculate the risk of infestation owing to flight characteristics and short distance movement of the insect (insect flight model, IFM), and the human facilitated agents like roads, campgrounds etc. (insect ride model, IRM). We combine the IFM and IRM to realize the potential risk of infestation in the near term.

Modelling approach: EAB-SHIFT calculates the probability of infestation of a currently unoccupied cell ($P_{i,t}$) based the habitat availability of ash (HQ_i), the abundance of EAB in the occupied cells ($F_{j,t}$), and the distance between occupied and unoccupied cells ($D_{i,j}$). C is calibrated to achieve a dispersal rate of 20 km/year and the value of x determines the rate of decline with distance. The infestation probability (0-1) for each unoccupied cell is summed across all occupied cells within

$$P_{i,t} = HQ_i\left(\sum_{j=1}^{n}\left(HQ_j \times F_{j,t} \times \left(\frac{C}{D_{i,j}^{x}}\right)\right)\right)$$

the search window at each generation. If cell sum is greater than one, it is considered infested. For cells with less than one, a random number between 0-1 is chosen and the cell is declared infested if that number is greater than the cell sum, adding an element of stochasticity. These newly infested cells contribute to the infestation probability of unoccupied cells in the next generation, assuming a 10-year generation time between initial infestation and complete death of ash.

Because Minnesota has recently been infested by EAB the core area of infestation is quite small - the IFM did not contribute much to the spread. With IRM, we boost the ash content of each cell by weighting the human facilitated factors in a GIS, contributing substantially to the risk of spread. The road network (weighted by average traffic density) contributes 40% to the overall weight; the roads most likely to be EAB transport routes (LETR) contribute 26% to the overall weight. LETRs were picked by assuming that people making campground reservations from eastern zip codes (likely carriers of EAB) would primarily travel via I-90 or I-94. The likely EAB transport routes were then chosen by visually selecting intersecting major roads leading to the campgrounds. The other human

facilitators included campgrounds (13%), sawmills (7%), firewood vendors (7%) and population density (7%).

Results: The preliminary map from the merger of IFM and IRM shows the risk of spread (see map). The areas near the Twin Cities are highly vulnerable as are the popular tourist attractions around Lake Mille Lacs. The northern areas of MN have large black ash resources in the swampy areas and are sites of high risk.

Conclusions: The modelled map can be used to prioritize monitoring locations with greatest risk of EAB infestation and delineate vulnerable areas. We are working closely with the Minnesota Department of Natural Resources to fine tune our model with better weights and model parameters. We also plan to rerun the model with newer core infestations when discovered to make the model more responsive to newer realities.