A MODEL FOR THE SPREAD OF THE EMERALD ASH BORER, *AGRILUS PLANIPENNIS*, IN RECENTLY COLONIZED SITES

Rodrigo J. Mercader[1], N.W. Siegert[1], A.M. Liebhold[2], and D.G. McCullough[1]

[1]Michigan State University, Department of Entomology, East Lansing, MI 48824

[2]USDA Forest Service, Northern Research Station, Morgantown, WV 26505

ABSTRACT

We developed a flexible model to predict the spread of the EAB in recently colonized sites. This model is structured as a coupled map lattice built around an interchangeable "phloem grid", which consists of a matrix of cells with estimates of the available phloem in each cell. Onto this lattice of ash phloem we coupled population processes of relevance to the spread of the EAB in three stages:

1- versus 2-year larval development

More than 200 trees across 18 different sites in Michigan were sampled to assess total density of EAB larvae per m2 of surface area. The density of 2-year and 1-year larvae in each sample tree was also recorded. Using regression analysis, we analyzed the proportion of 2-year larvae by larval density. As in previous studies, we found a significant negative correlation between the proportion of larvae that require 2 years for development and larval density ($F_{1,17} = 60.83$, $P < 0.001$), and a reasonably good fit ($r2 = 0.77$). This relationship was used in the model to estimate the proportion of beetles developing in 1 or 2 years.

Adult dispersal

Dispersal was determined using a negative exponential function estimated from data gathered from an infestation originating from a single point source in an isolated area in Fowlerville, MI. Sections of all ash trees on the site were debarked and the density of EAB larvae per m2 of exposed phloem was recorded for each 10-m radius around the point source. We fit three likely models to this data using a maximum likelihood approach. (Ricker function (RF), negative exponential function (NEF), inverse power function (IPF). The NEF fit the data best (AICc = 949.5, 117.7, and 321.5, respectively) and provided a very tight fit ($r2 = 0.93$). To validate this model, we contrasted the model predictions to data from a second site located near Tipton, MI (Lenawee Co.). The infestation from this site, discovered in 2002, originated from a pile of infested wood near a wooded creek surrounded by agricultural fields, effectively creating a bidirectional corridor. As with the data above, we estimated the proportion of larvae per m2 of exposed phloem, and contrasted the observed results with the predicted results. The predicted results fit the observed data fairly tightly ($r2 = 0.6$).

Population growth and phloem consumption

After adult beetles disperse, the number of larvae expected to survive was determined based on the estimated growth rate from an outlier population in Ingham Co., MI. The quantity of phloem consumed by an individual larva was estimated from McCullough and Siegert (2007) to be 0.0113 m^2 of phloem per larvae. Population growth in the model is not allowed to exceed the maximum number of larvae that can develop from the available ash phloem resource.

Literature Cited

McCullough, D.G.; Siegert, N.W. 2007. **Estimating potential emerald ash borer (*Agrilus planipennis* Fairmaire) populations using ash inventory data**. Journal of Economic Entomology. 100: 1577–1586.