United States
Department of
Agriculture

Forest Service

Northern Research
Station

General Technical
Report NRS-P-28

Proceedings
18th U.S. Department of Agriculture Interagency Research Forum on Gypsy Moth and Other Invasive Species, 2007

SPATIOTEMPORAL DYNAMICS OF INVASIVE BARK BEETLES: MODELING DISPERSAL STRATEGIES

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ABSTRACT

Extensive timber imports represent potential introduction pathways for exotic bark beetles (Col: Scolytidae) that may pose ecological hazards and economical risks to native forests. One such species, *Ips amitinus* Eichh., has been intercepted several times at Norwegian ports of entry in the years since 2002, the year of the first Scandinavian record. Detection of overwintering individuals of *I. amitinus* at the timber storage site of import timber and preliminary results of a stepwise import model may suggest a high risk of establishment and spread in Norway spruce forests in Scandinavia.

Using various modeling approaches, our goal is to reduce the risk of introduction, establishment, and spread of introduced bark beetles. Our objectives are to (1) model the processes of dispersal and establishment of arriving bark beetles; (2) explore to what extent an introduced species interacting with native *Ips typographus* L., the most dominant species in Norway spruce, will lead to stronger and more frequent outbreaks of *I. typographus*; (3) assess potential patterns of spread of newly established bark beetle species and the spatiotemporal outbreak dynamics resulting from interactions between native and introduced species; and (4) advise on the implications for forest industry and management.

Here we present current efforts to model dispersal (objective 1). Dispersal patterns, and hence rates of establishment and spread, may vary considerably depending on dispersal behaviors of insects, such as directionality of movement and aggregation propensity. To assess underlying assumptions of dispersal models, we are using an individual-based model where traits governing dispersal are inherited with random mutations. Individual reproductive success is determined by resource availability and density-dependence in a simulated landscape governed by external forces (e.g., windfellings) and beetle activity (consumption of resources). Evolvable traits include straight line vs. random-walk flight paths and aggregation propensity. Model simulations show that the chance of successful reproduction is greatest for intermediate to high levels of directionality, and that directionality increases over time up to a certain point determined by the landscape features as well as other traits of the species. Assuming limited (local) information in a stochastic landscape, intermediate to high degree of flight directionality is selected for.