



## Predicting Jack Pine Budworm Defoliation

### INTRODUCTION

Jack pine budworm (*Choristoneura pinus pinus* Free.), an insect pest native to North America, is the most serious pest of jack pine. In Canada, it occurs throughout the range of jack pine, but is found mainly in Northern Ontario, Manitoba and Saskatchewan. It can cause major economic losses in jack pine stands and is occasionally found in white pine stands. Budworm larvae feed on foliage in the upper part of the crown, resulting in significant defoliation and top kill. This damage causes competition between lateral branches for the establishment of a new dominant shoot and causes growth loss. Repeated infestations can result in tree mortality.



In Ontario, outbreaks of jack pine budworm typically occur every 8-10 years and last 2-4 years in forest stands. At the peak of the most recent outbreak in 2006, over 740,000 ha were infested. An outbreak in the 1980s caused estimated volume losses of 3.5 million m<sup>3</sup> from growth suppression and 7.3 million m<sup>3</sup> from mortality. A better understanding of the ecological interactions between the insect and its host species will help managers predict the risk of defoliation and develop effective management strategies for dealing with future outbreaks.

### GREAT LAKES FORESTRY CENTRE ROLE

GLFC scientist Chris MacQuarrie examined 15 years (1992-2007) of jack pine budworm defoliation data from 180 sites in Ontario. These sites were established in areas that had been defoliated during an extensive outbreak of the jack pine budworm in the 1980s. The sites covered a range of forest types, stand ages and site compositions.

### Previous studies

Previous studies that examined data from these sites to better understand the ecological interaction between jack pine budworm and its host found that the abundance of pollen cones was an important factor in predicting the survivorship and performance of the insect because early in the season, emerging larvae feed on

pollen cones until new foliage appears. Not all trees produce these cones every year, so their presence is an important factor in budworm survival. Site quality, stand condition and the presence of natural enemies were other important factors identified.

### Current analysis

In this analysis, a number of biotic and abiotic factors were considered, including stand, tree and insect variables, with the aim of identifying the ones most useful as predictors of budworm defoliation. The data

were analyzed in a new way, using a powerful statistical analysis technique known as boosted tree regression, that selected the best combination of variables to determine which ones were positively associated with jack pine budworm defoliation. Of the original 51 variables tested, 18 were identified as having some degree of importance. These included: plot features, such as slope, aspect, forest composition and stand density; soil features, including soil type, texture and moisture; individual tree parameters, such as diameter, height and crown height; the number and proportion of trees with pollen cones; previous year's damage, whether from budworm or other insects; and the presence of cankers. It appears that the best predictor of current jack pine budworm defoliation is the amount of defoliation experienced in the previous year and the texture and type of the soil in the plots.

### Implications

The significance of soil characteristics is interesting to researchers, because although previous work suggested that the likelihood a stand will be defoliated by jack pine budworm is strongly influenced by site, the specific factors responsible were not identified. If these findings can be substantiated, it would mean that future risk analyses would need to consider the soil composition of the stand when predictions are made. It would also give some insight into how much the relationship between jack pine budworm and its host may be influenced by the growing conditions of the tree.

### Future work

A follow up series of experiments will test the emergent hypothesis that soil composition influences the population dynamics and intensity of defoliation of jack pine by jack pine budworm. The findings of these analyses will then be correlated against the observed defoliation in each of the stands to determine if certain soil properties have an influence on the intensity of defoliation. It is hoped that results from this work will lead to a better understanding of the relationship between jack pine budworm and jack pine.

### CONCLUSION

Jack pine budworm has the potential to cause serious growth loss and even mortality, negatively affecting the forest economy. Advanced analysis of numerous site, stand and individual tree factors has identified potentially important predictors of jack pine budworm defoliation. This enhanced understanding of the ecological interactions occurring in jack pine stands when budworm is present will assist in the development of more accurate means to estimate its impact and improve our efforts to manage this significant defoliator.

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