Coarse resolution satellite mapping of insect-induced tree defoliation and mortality

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***Abstract* - Insect-induced tree defoliation and the resulting growth and mortality losses represent a significant disturbance in many forested regions. Most defoliation surveys are produced using conventional aerial sketch mapping techniques supplemented by field inspection. Digital airborne and fine resolution (≤ 100m) satellite imagery has been frequently used, with mixed results, to assess both the extent and severity of defoliation [1-3]. Coarse resolution (~ 1-km) satellite imagery, with its greater frequency of observation and spatial coverage, could also prove useful for monitoring and mapping large-scale defoliation events. The purpose of this study was to assess the potential for using multi-temporal SPOT VEGETATION (VGT) imagery for monitoring insect defoliation and mapping subsequent tree mortality. VGT imagery was examined for a severe outbreak of hemlock looper (*Lambdina fiscellaria*) in Quebec, Canada, which defoliated and killed more than 400,000 ha of balsam fir in 1999 (Fig 1). Multi-temporal change metrics [4] based on reflectance and vegetation indices were derived using 10-day VGT composites from 1998-2000. A multiple logistic regression model developed using the 1998-2000 metrics could classify forest mortality within a 500-by-700 km study area with a commission error of 33-60 percent and omission error of 0-33 percent, depending on if the reference surveys were buffered by 2 km (Fig. 2). The logistic model was also applied to simulate a near real-time application for detecting defoliation and monitoring its evolution. A time-series of 1999 change metrics could detect defoliation after July larval feeding with an omission error rate comparable to that from mapping mortality. However, the number of false detections was 2-3 times greater due to short-term variation in the satellite signal not related to real vegetation changes (e.g., cloud and atmospheric contamination, surface moisture). We conclude that coarse resolution imagery demonstrates considerable promise for monitoring insect defoliation and should be investigated for a range of defoliators and forest types.**

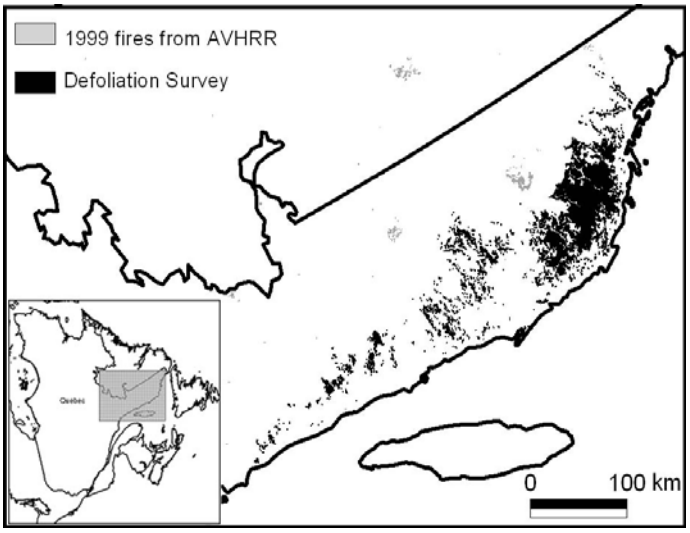

Fig. 1. Location of 500km by 700km study region in Quebec, Canada. The defoliation survey conducted using aircraft is shown in black.

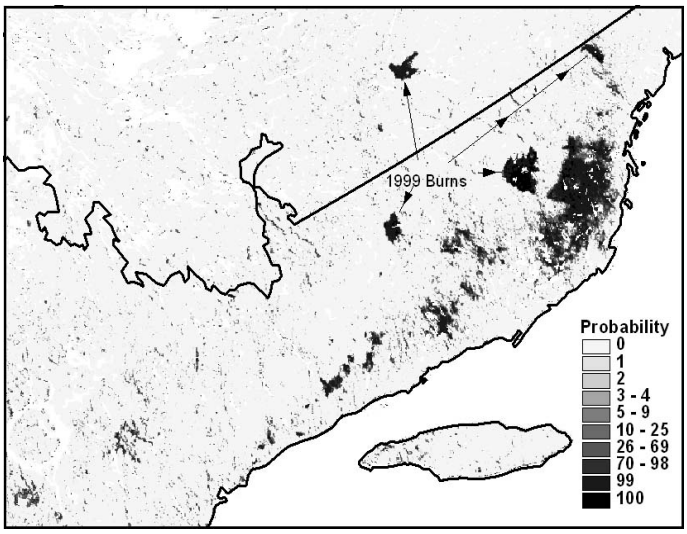

Fig. 2. Probability of mortality in 2000 from insect defoliation derived using the multiple logistic regression model.

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