Oviposition traps to survey for population trends and defoliation prediction of the western hemlock looper (*Lambdina fiscellaria lugubrosa*) (Lepidoptera: Geometridae) in British Columbia.

**FSP Project Number: Y073184**

**FINAL TECHNICAL REPORT**

**EXECUTIVE SUMMARY**

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Introduction

Considerable time and effort is expended annually in BC on defoliator management. Impacts of defoliator outbreaks include growth loss, top kill and tree mortality, and degradation of viewscapes. It is desirable to apply direct controls as accurately and precisely as possible in order to ensure maximum impact on damaging agents for each dollar of expenditure.

Outbreaks of the western hemlock looper (WHL) are characterized by rapid increase, patchy distribution. Significant and extensive tree mortality over large areas in mature cedar-hemlock-spruce forests of BC represents a serious disruption to normal economic and operational planning, and resulted in unsalvaged timber volume loss (Unger and Stewart 1996, Ward 1999). Outbreaks occur approximately every 10 years, and last about 4 years (Turnquist 1991). An outbreak began in south-eastern BC about 2000.

An effective 2-stage system is used in British Columbia to estimate population trends and expected defoliation intensity over the course of a WHL outbreak. In the first stage, labour intensive larval sampling by 3-tree beating is used annually during periods of sub-outbreak population levels, usually at permanent sample plots. Once a threshold number of larvae are reached an outbreak is usually imminent either locally or at the landscape level, within 2 years (Turnquist 1991, Ferris 1992).

The second stage of population forecasting, during outbreaks, consists of lichen collection from branches on hemlock trees in infested stands. With this information management activities such as targeted harvesting or organic insecticide sprays can be planned to mitigate losses.

The current process for collecting and counting eggs is arduous, tedious, time-consuming, and expensive, and requires a specialised extraction process (Hébert et al. 2003). A strip of white polyurethane foam as a passive oviposition trap has been tested for eastern hemlock looper (Hébert et al. 2003, Hébert and St. Antoine 1999). Good results were obtained using the passive trap attached to trees at dbh.

Our objectives were to 1: Test the potential of a new artificial substrate egg sampling technology for predicting western hemlock looper population trends and defoliation severity...
in British; and, 2: Compare the efficacy and cost-effectiveness of the new sampling technology against current sampling technologies for WHL.

There are direct linkages to ongoing or planned work. Partners Dr. Maclauchlan (Btk application) and Dr. Otvos (long-term population monitoring using adult moth traps, and hazard and risk assessment) are both conducting research on the western hemlock looper. Their work is aimed at providing decision makers with improved tools to assess hazard and risk to resource management objectives, formulate management options, and choose appropriate paths of action. This project proposal was designed to be complimentary to their ongoing work, and further improve the tools available to decision makers.

Methods and materials

Twenty field sites were selected from among established permanent sample plots (PSPs) in use by the BC Ministry of Forests and Range (BC MOFR) and Canadian Forest Services (CFS) in southeast BC for monitoring larval counts, adult moth trap catches, and lichen egg counts (Figure 1). This approach provided readily accessible simultaneous calibration data from established monitoring methods (eggs per 100 g of lichen and larval counts from tree beatings), and one experimental method (adult male moth catches in pheromone baited traps) to compare directly against the oviposition trap (OT) catches.

Sampling effort was 0.90 m² of OT surface area per site (ten 20 x 45 cm white polyurethane foam strip traps at dbh). Hemlock looper eggs on the OTs were counted under magnification, and classified as healthy or parasitized using a protocol developed by the CFS (Personal Communication, Dr. Imre Otvos, Research Scientist, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Rd., Victoria, BC V8Z 1M5).

Moth trap setup (by the Canadian Forest Service) was mid- to late July annually, and collection was late September or early October (Evenden et al. 1995b).

Larval sampling was conducted by the BC MOFR using 3-tree beatings (Turnquist 1991) during July each year. One site (Cranberry Ck) which was not a previously established PSP, did not have larval collections.
Figure 1. Location of Canadian Forest Service and BC Forest Service permanent sample plots selected for testing western hemlock looper passive oviposition traps in south-eastern British Columbia.

Results and Discussion
Weak “end of outbreak” WHL populations collapsed during the 3 years 2004 – 2006 (Westfall 2005). No current defoliation was noted in any year. There were sufficient data to compare sample techniques in 2004 only.

Spearman’s rank correlation (Zar 1984, R Development Core Team 2004) indicated a correlation between 2004 larval counts and eggs on foam substrate (p = 0.05). This suggests good potential for monitoring sub-outbreak populations. SRC indicated no significant relationship between eggs per 100g of lichen and eggs on foam substrate (p = 0.10), or moths per site and eggs on foam substrate (p = 0.10).

From 2004 to 2005 the total number of fertile eggs from lichen collections declined from 41.5 to 0. Fertile egg counts on the foam OTs showed a similar decline. A total of 31.9 eggs per m² were collected in 2004. This dropped to 0 by 2006, but the OT’s did not go to zero in 2005, which differs from the lichen egg counts. Catches of male moths declined by 70.6 % from 2181 to 446. Larval counts declined from 264 to 2.

Trap “durability” was excellent. There were 3 of 200 traps down in 2004, 9 of 190 in 2005, and 1 of 180 in 2006.

Cost comparisons indicated that the oviposition trap method was at least 36% cheaper than lichen sampling. The ease and speed of the foam strip application, the fact that it can be installed by non-specialised technical staff already working in the area (e.g. licensee or BCMOF woodlands staff), and the much easier egg counting process, suggested that there would be a substantial cost savings using the foam strips.

Conclusions

This study was initiated during the collapse of a western hemlock looper outbreak in southeast British Columbia. The foam passive oviposition traps show excellent potential for monitoring western hemlock looper population levels and trends in British Columbia. The significant correlation to larval counts in 2004 suggests that the OTs show an ideal insensitivity at low WHL populations (Hébert et al. 2003) and may be a suitable substitute for larval sampling. This needs to be confirmed by continued sampling. Further, we think that visual assessment of the data does not necessarily rule out a correlation between
Further work will test the traps annually up to and through the next outbreak cycle. This will ensure that the technique is viable and calibrated against the current standard population estimation procedures with known thresholds from low endemic through to outbreak WHL populations.

Based on our results a sampling layout of 10 trees spaced at 10 m in a line through a stand, with 1 trap per tree will give satisfactory results. Further research can examine lower sampling intensities.

In order to minimise costs, and provide the public with assurance, it is imperative that BC be seen to be using the best available cost-effective technologies. For defoliator monitoring, advances in fields such as pheromone biology and use, and oviposition sampling, mean that new technologies are available that can provide reduced survey costs with as good or better results. These results can in turn be used to improve the cost-benefit and targeting of direct control operations such as harvesting or spraying. This project addressed a new technology that has the potential to provide these benefits, as well as complimenting past and current research. In the medium to long-term, we envision the possibility that larval sampling will be replaced by adult moth trapping, and lichen sampling replaced by artificial substrates.

If the new oviposition sampling system proves efficacious, then BC will have a standardised, cheaper, easier, and more robust method that can be installed and collected by non-specialists, and rapidly and easily assessed. The technique could fit smoothly into, and add to the accuracy of, the current monitoring system for WHL. The result will be a monitoring system that is faster, easier, and cheaper to install and process, with greater consistency and reliability, and at least the same accuracy and precision, as the current system.

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References


