EXECUTIVE SUMMARY

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: LOI Y062184

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Arthur J. Stock\(^1\), Entomologist, BC Ministry of Forests and Range, 1907 Ridgewood Rd., Nelson, BC V1L 6K1

Marnie Duthie-Holt, Entomologist, Medifor Forest Health Consulting, 2715-8th St S., Cranbrook, BC V1C 4N1

\(^1\) Corresponding author.
Project purpose and management implications
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.

Direct control of defoliators, e.g. by spraying of microbial insecticides, is not always desirable, and is often fraught with controversy. However, as pressure intensifies on both consumptive and non-consumptive forest resource utilisation, direct control will probably remain part of forest management practices. Dynamic sustainable forest management will require periodic protection of habitat values such as old growth or viewscapes, and of investments such as regeneration or standing timber. Therefore it is desirable, if possible, 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, and significant and extensive tree mortality over large areas in mature cedar-hemlock-spruce forests of BC. Outbreaks occur approximately every 10 years, and last about 4 years (Turnquist 1991). During the previous outbreak (1990-1994) WHL was estimated to have killed 5.5 million cubic metres of timber in the former Nelson Region alone (Unger and Stewart 1996). This represented a serious disruption to normal economic and operational planning, and resulted in unsalvaged timber volume loss (Ward 1999). There was a current outbreak in south-eastern BC, which began 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).
Numbers of captured larvae are often so large during an outbreak that no predictions of population trends or defoliation can be made. This leads to the second stage of population forecasting, consisting of lichen collection from branches on hemlock trees in infested stands. Lichen is a preferred, but not exclusive, substrate for adult female looper moths to lay eggs (Ferris 1992). A hot water or bleach wash is used to separate the eggs from the lichen, and the viable overwintering eggs are then counted per 100 g of lichen (Turnquist 1991, Ferris 1992, Otvos and Bryant 1972, Shore 1990). Known thresholds of egg counts, modified by percent parasitism of the eggs, provide an estimate of expected population trends and defoliation (Turnquist 1991, Ferris 1992). 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). Other disadvantages of this sampling system are that lichen is not always abundant at preferred sample sites, and old eggs left on the lichen need to be separated out before viable eggs can be counted (Hébert et al. 2003). Despite these disadvantages, the process is an improvement over the original sampling system, which obtained mid-crown lichen samples from felled trees (Thomson 1958). Even so, a simpler, less arduous procedure might allow more sample sites at a similar or reduced overall cost, with a concomitant increase in accuracy of forecasting defoliation location and intensity (Hébert and St. Antoine 1999).

A strip of 20 x 40 cm white polyurethane foam as a passive oviposition trap has been tested for eastern hemlock looper (Hébert et al. 2003). Good results were obtained using the passive trap attached to trees at dbh. Lichen abundance is not necessary, and old eggs are not an issue since the strips are placed out and removed annually.

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

**Project start date and former project numbers.**
The project started in 2004 as Project Y051184, and continued in 2005 as Project Y062184.

**Methodology overview**
Field sites were selected from among established permanent sample sites (PSP) in use by the BC and Canadian Forest Services (BCMOF and CFS) in southeast BC for monitoring larval counts, adult moth trap catches, and lichen egg counts. 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. There were a total of 58 potential sites, of which 20 with currently active looper populations were selected.

Two foam OTs were applied prior to moth flight to each of 5 trees at each site in 2004, but only 1 foam was applied to each of 10 trees in 2005. The 2005 sampling regime appeared to be more efficient because it covered relatively more area within a given stand for an equal effort.

**Project scope and regional applicability**
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 addresses 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. 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.

We anticipate that the results of the project will be applicable within the range of the western hemlock looper in western North America.

There are direct linkages to ongoing work in British Columbia. 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.

**Preliminary Results and Discussion**

The first year of this study (2004) was during the apparent collapse of the current western hemlock looper outbreak in south-east British Columbia with no defoliation indicated for 2005. In fact, no defoliation was noted during surveys in 2005. Results from larval sampling, adult male moth catches, and lichen sampling all indicated that population levels had declined to endemic levels by 2005, and no defoliation is indicated for summer 2006. Oviposition traps had egg counts at 45% of 21 sites in 2004, but only 2 eggs were found in total in 2005.

Cost comparisons indicated that the oviposition trap method was about 36% cheaper than lichen sampling.

It was necessary to test the foam strip sampling annually until the outbreak completely subsided. This ensured that the technique was viable and calibrated against the current standard population estimation procedures at least from outbreak collapse through to low
endemic WHL populations. The foam strip appeared to be quite insensitive at endemic WHL populations in 2005, which was an excellent result (Hébert et al. 2003) because it eliminates the background “noise” that can occur with larval and moth sampling, and may allow for relatively earlier detection of increasing populations. Ideally, the strips should be tested against other sampling methods up to and through the next outbreak.

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References


