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Leptoglossus Mark-Release-Recapture Study

(BC Ministry of Forests- 500751YVT007)

May 06-March 07

Background

The western conifer seed bug, *Leptoglossus occidentalis*, is the number one pest for conifer seed orchards. Despite multiple yearly pesticide applications, this pest still causes significant seed loss, and is therefore an economic concern for the reforestation programs in British Columbia. More information is required to improve monitoring protocol and develop efficient and effective pest management strategies.

The proposed research project combines a series of field investigations with quantitative analysis and mathematical modeling. The field component consists of mark-recapture studies designed to provide the quantitative data necessary to estimate population density within orchards, and allow us to gain a better understanding of movement both within and between orchards. The follow- up quantitative explorations and mathematical models should enable us to make useful predictions regarding movement patterns of adults, and population dynamics of *L. occidentalis* in general. These, combined with actual monitoring results and seed loss, will be used to devise economic thresholds for the industry.

As a first step, we have completed a series of activities designed to develop and test methods of marking, releasing, and recapturing insects. This document reports on the activities conducted in the summer of 2006.

The approved objectives were:

1. Test marking methods and measure the effect on survivorship of the insect.
2. Assess the methods of collecting, marking, and releasing.
3. Collect preliminary data on dispersal and population density.

Methods

I. Effect of marking on survival

We evaluated potential effects of different marking methods on survival of overwintered Leptoglossus adults in the field. We placed 3 adults into each of 20 mesh nylon sleeves on branches of ponderosa pine on the UBC Okangan properties. Adults in each sleeve were either unmarked (control), painted on the right hemelytron with water-based acrylic (paint) or thoroughly dusted with yellow fluorescent powder (powder). Sleeves were visited regularly (usually daily) and numbers of expired bugs were counted. There were no measurable effects of mark type on either pattern of survivorship or average longevity. (See figure 1 and 2 in Appendix 1.)

II. Pilot mark-release-recapture study

The field work, which consisted of a series of mark-recapture studies, was conducted in the test orchards at the Kalamalka Research Center.

To test our methods and obtain preliminary data on dispersal and population density, we conducted individual mark-release-recapture studies in three different blocks: B15 (spruce), B9 (white pine), and B7 (larch). Insects were captured and brought back to

the lab for processing. Both adults and nymphs were collected using a beating stick and a small tub covered with a funnel shaped top. The interior of the tubs was coated with an adhesive material to prevent flying adults from escaping. Adults were marked and immediately released. Collected nymphs were raised in captivity, then marked and released at maturity. To easily differentiate insects captured and released at different locations, the pronotum of the adult insects was painted using three different colours of acrylic paint: yellow oxide (B7), burnt sienna (B9), and raw sienna (B15). Earth shades were selected to ensure that marked insects would not attract predators. In addition, each insect was individually numbered with a permanent fine-tipped pen.

We experimented with three types of release patterns: a uniform release (B15), a point release in the center of a block (B9), and a line release at the edge of the orchard (B7). Individual insects were released in the same block from which they were captured. All insects captured in locations other than B15 and B9 were either released in B7, or used in the mass mark-release experiments. Each block was sampled several times during the study. Where appropriate, we also monitored neighbouring blocks for the presence of marked individuals. Whenever possible, we recorded the colour of the mark, the code number of the individual, the date and time, and the location for each recapture event with high-accuracy GPS instruments, and released the individual on site.

We also conducted mass mark-releases to assess our method's potential to generate data on overwinter survival and return rates. We used two methods of marking. We painted the pronotums of 300 individuals with a fluorescent pink paint. We used a fluorescent blue paint on a smaller group of 60 individuals for colour comparison. A second group of 300 individuals was dusted with a fluorescent yellow powder.

Results & Discussion

The mark-release-recapture studies were conducted from July 17 to August 9. In total, 2,496 individual insects were marked and released using three different marking methods: acrylic paint with numbers, fluorescent paint, and fluorescent powder. The yellow oxide and raw sienna acrylic paint, and the fluorescent pink (which dried to a dark glossy red) worked best. The burnt sienna acrylic paint and the fluorescent blue were hard to identify in the field. In some cases, individual insects that had been marked and numbered using the burnt sienna acrylic paint were mistakenly brought back to the lab for marking. With these recaptures, we were unable to record their original recapture location, and information that would have been useful in determining dispersal distances was therefore lost. The adults treated with the fluorescent powder tended not to disperse at release time because the powder interfered with their wings. Most of them could not fly on their own, and were placed on trees near the release location. Many were still located on the same trees several days after the release, and a few mortalities were observed.

Capture and recapture efforts were affected by the distribution of cones in the blocks, and the tree size and species. Fewer captures were made in the larch block (B7), characterized by tightly spaced mature trees densely covered with small cones, because insects were hard to find and the time required to scan each tree considerable. By contrast, the small white pine block (B9), filled with short compact trees covered with large hanging cones, was easy to survey, but because of the close proximity of the cones many insects escaped

before they could be captured. The spruce block (B15) contained trees of various sizes; however, the cones were distributed unevenly both throughout the block and on each tree, which made it easier to capture insects. Most of the other blocks were unsuitable for the study either because the trees were too tall, which meant that most insects could not be reached, or because most trees had no fresh cones to attract insects.

Approximately 8% of the marked individuals were recaptured. The number for recaptures was lower during the first week of the study most likely due to variations in handling adult insects. Initially, adult insects were stored for a short period in colder temperature so they would be easier to mark. This process caused undue stress on the insects and was discontinued. We also observed that adult insects were negatively impacted by a lengthy captivity. Best results were obtained when the insects were marked and released within a few hours of the original capture. Marking the individuals in the field would improve the quality of the data and ensure that the marking process has minimal impact on the insect.

The average distance between release and recapture locations was 39.4 meters with a maximum of 199.5 meters for the mark-release-recapture, and 26.8 meters with a maximum of 194.3 meters for the mass mark-release experiment. We used the data collected in the mark-recapture experiments to generate weighted means population estimates for the sites monitored during the study.

TABLE 1. Population Estimates

Site	N	Standard Error
larch block (B7)	*	*
pine block (B9)	1425	±311
spruce block (B15)	1059	±274
All blocks	6972	±822

*** Insufficient data available**

The results of the mark-recapture-release study are summarized in Appendix 2. A full spatial analysis of the data will be conducted by a mathematics student in the summer of 2007. The mathematical component of the project will begin during the principal investigator's study leave (July 2007-June 2008). We recommend that a full-scale mark-release-recapture study, spanning the entire period of activity of *L. occidentalis*, be undertaken.

Acknowledgements

I would like to thank my research assistants, Julie Brown, Sadie Mae Quintal, Kylee Seddon-Johnstone, and Darcy Knight, for their dedicated work and their active participation in the mark-recapture study; my colleague at UBC Okanagan, Dr. Robert Lalonde, for his professional advice; Dr. Ward Strong and the Kalamalka Forestry Center for allowing us to conduct the field experiment at their facilities; and the BC Ministry of Forests and Ranges, and MITACS for their generous contributions to the project.

Appendix 1

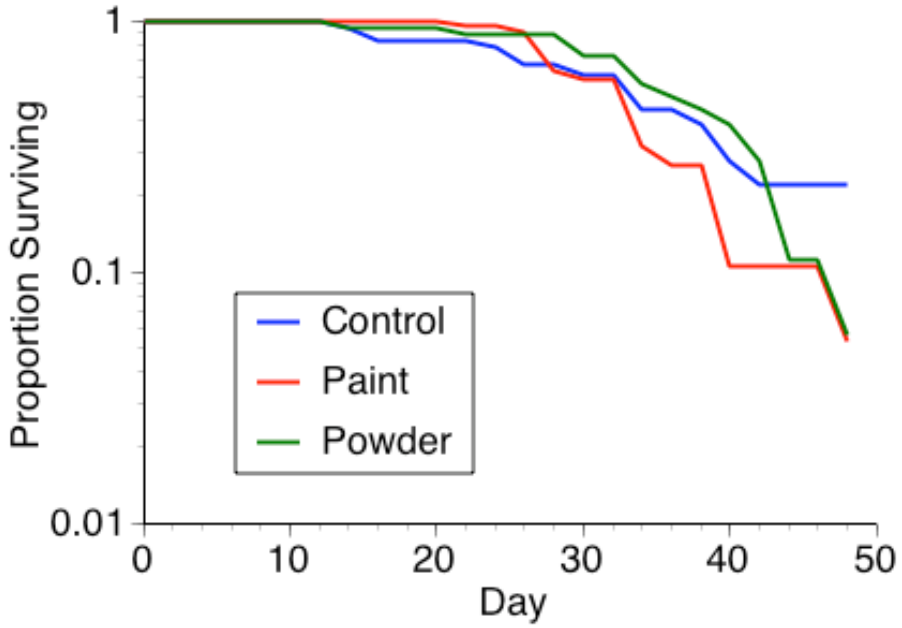

Figure 1. Survivoship of overwintered adult Leptoglossus occidentalis as affected by type of mark.

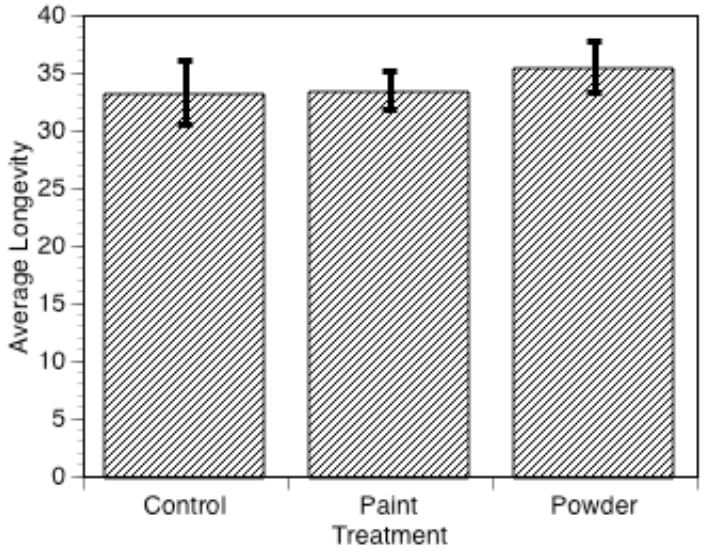

Figure 2. Average longevity of overwintered adult Leptoglossus as affected by type of mark.

Appendix 2

Table 1. Mark-release-recapture

		CAPTURED					MOLTED				RELEASED				RECAPTURED				
Day	Date	Spruce	Pine	Larch	other	TOTAL	Spruce	Pine	Mixed	TOTAL	Spruce	Pine	Larch	TOTAL	Spruce	Pine	Larch	Other	TOTAL
1	7/17/06	24				24				0				0					0
2	7/18/06	27				27			51	51	51		51	102					0
3	7/19/06	22	50			72			29	29	22	50	29	101	2				2
4	7/20/06	19	20	6	14	59	1	5	27	33	20	25	47	92	1	7	3		11
5	7/24/06	73	121			194				0	73	121		194	3	1			4
6	7/25/06		32	83	110	225	51	4		55	51	36	110	197	3	7	9		19
7	7/26/06	28	24		108	160			28	28	28	24	219	271	9	7		2	18
8	7/27/06			21		21	52	26	101	179	52	26	122	200			2		2
9	8/1/06	101	17			118	52		124	176	153		124	277	13	6			19
10	8/2/06				300	300		24		24		41		41					0
11	8/3/06	137			300	437				0	137			137	34			1	35
12	8/4/06	74	16			90			60	60	74	16		90	14	3		1	18
13	8/8/06	95	39			134				0	95	39		134				2	2
14	8/9/06					0				0				0	28			1	29
		600	319	110	832	1861	156	59	420	635	756	378	702	1836	107	31	14	7	159

Table 2. Mass mark-release

		RELEASED					SIGHTINGS												
	Date	Pink	Yellow	Blue	TOTAL		Pink	Yellow	Blue	TOTAL									
	8/2/06	300			300														
	8/3/06		300		300		23	1		24									
	8/4/06			60	60		8	7		15									
	8/8/06								1	1									
	8/9/06						2	18	3	23									
		300	300	60	660		33	26	4	63									

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Expected Revenue

	2006	2007
BC Ministry of Forests & Range	$ 10,388	
MITACS		$10,388
Total Revenue	**$10,388**	**$10,388**

Expenses

May 2006 - March 2007	
Student Salaries & Benefits (350 student man-hours)	5,322
Travel & Accommodation	2,387
Equipment	299
Supplies	78
Total	$ 8086

* The amounts remaining from the 2006 funding ($2,302$) will be used to monitor the study site for returning insects during the spring of 2007. The matching funding from MITACS will be used to pay for the cost of research associated with this project. At least 70% of this amount shall cover the stipend for a student working full-time on the quantitative analysis of the data and the development of mathematical models that will contribute to our knowledge and understanding of the population dynamics and dispersal of the western conifer seedbug, *Leptoglossus occidentalis*.

* Additional funding for a graduate student or post graduate fellow in biology should be available through the BC Industrial Internship Program. For more information contact Laurence Meadows (778.782.7372) or visit www.mitacsinternships.ca.