RELATIONSHIPS BETWEEN TOTAL POPULATION COUNTS OF GLASSY-WINGED SHARPSHOOTERS AND NUMBERS OBTAINED FROM VARIOUS SAMPLING METHODS

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REPORTING PERIOD: These results are from work conducted between October 2002 through October 2003

ABSTRACT
We seek to understand the way in which commonly used sampling methods work, in relation with real population densities. We used short citrus experimental trees and commercial-size ones, in order to encompass most of the size range of plants that are important hosts to GWSS. At the University of California, Agricultural Operations, Riverside, California, we conducted two series of experiments in citrus with natural GWSS populations. The trees were 2 m tall navel oranges that have been blocked, shaped, and skirted for uniformity within the block, as well as commercial-sized citrus trees. We compared visual counts (adults and nymphs), beat-net (adults, early nymphs and late nymphs), and yellow sticky cards (adults), with the absolute GWSS density for each tree using the tent-fogging methodology. We used fluorescent colored dust to mark 100 GWSS released inside the tents to determine the percentage recovery. These surveys were conducted every other week from June 2002 through September 2003. The results showed significant correlations between the methods and real population densities, with R^2 values that ranged from 0.19 to 0.84. The results how that correlations are better from small trees and bushes, but also that for commercial-size trees most of the methods can explain close to 50% of the real population size. We seek now to include temperature, wind, rain, and cloud coverage data to a multivariate analysis in order to explore whether that would improve the correlations, and thus to better assess the predictive value of the most commonly used sampling methods for GWSS.

INTRODUCTION
Most of our knowledge of GWSS dispersion has been obtained with relative sampling methods in vineyards and citrus orchards. Currently, sampling methods are being used to determine timing of pesticide treatments and to judge their efficacy (e.g., General Beale project, Bakersfield). This use implies that the sampling method used relates in a known way to population density. Unfortunately, this is not the case, and some important questions are raised. If a given treatment against GWSS results in "zero counts" by beat sampling, does that necessarily indicate that there are no GWSS in the area due to the treatments, or could some GWSS be left alive but at density below the detection threshold of the monitoring tool? Could an unknown low density of GWSS be enough to vector PD within or between treated areas? Does the relationship between population sampling precision and accuracy change seasonally?

OBJECTIVES
The goal of our research is to correlate the numbers of *Homalodisca coagulata* (glassy-winged sharpshooter, GWSS) obtained by various sampling methods currently used in GWSS population monitoring with the population density of GWSS in the flora sampled.

RESULTS
We ran the regressions for both datasets separately. The aim was to see whether the dataset from small trees, which are a good model for bushes, show similar correlations that those of commercial-sized trees, for these two extremes in size encompass most of the types of GWSS hosts.

Obtaining relative estimates and absolute counts from short experimental trees.
The dataset analyzed covers from July 2002 through September 2003 (21 dates). Nymph data from small experimental trees showed significant correlations between total counts and beat net and timed visual counts. These regressions had an R^2 = 0.82, and 0.84 respectively (Table 1). Adult data from the same small experimental trees showed significant correlations between all the methods tested. The regression of sticky card data on total counts, for instance, explains close to 50% of the variance of sticky card data. Beat net and visual counts are less accurate when compared with actual population densities per tree (Table 2).

Table 1. P-values and R^2 (in parenthesis) data for the regressions for juvenile GWSS counts from data from short experimental citrus trees.

Juvenile GWSS	Total counts	Sticky card	Beat net	Timed counts
Total counts	---			
Sticky card	X	---		
Beat net	< 0.0001 (0.82)	X	---	
Timed counts (visual)	< 0.0001 (0.84)	X	<0.0001 (0.71)	---

X: No nymph data was collected from sticky traps.

Table 2. P-values and R^2 (in parenthesis) data for the regressions for adult GWSS counts from data from short experimental citrus trees.

Adult GWSS	Total counts	Sticky card	Beat net	Timed counts
Total counts	---			
Sticky card	0.0002 (0.50)	---		
Beat net	< 0.0001 (0.48)	0.0001 (0.57)	---	
Timed counts (visual)	< 0.0001 (0.35)	0.01 (0.26)	< 0.0001 (0.73)	---

Obtaining sampling and total counts from commercial-sized citrus

The dataset analyzed from commercially-sized citrus trees covers from April through July 2003 (13 dates). For these citrus trees, there was no correlation between any of the methods tested for juvenile GWSS. Only the data from beat net samplings supported analysis. Data from timed counts returned zeros for most dates and could not be analyzed. No nymph data was collected from sticky traps. The adult dataset showed significant correlations, but very low R-squared values (Table 4). This results suggest that the prediction value of all this methods seems thus to be low in terms of real adult GWSS densities per tree.

Table 3. P-values and R^2 (in parenthesis) data for the regressions for adult counts from data from commercially-sized trees.

Adult GWSS	Total counts	Sticky card	Beat net	Timed counts
Total counts	---			
Sticky card	0.0052 (0.48)	---		
Beat net	< 0.0001 (0.46)	0.002 (0.59)	---	
Timed counts (visual)	0.0056 (0.19)	0.0070 (0.49)	0.0036 (0.20)	---

CONCLUSIONS

These results show that the sampling systems commonly used to measure GWSS populations can explain close to 50% of the adult GWSS field population density on commercial citrus trees. The estimations based on smaller host plants are in excess of 80%. Beat net and visual counts seem to be reliable methods to assess juvenile GWSS densities at least in small trees and bushes. It is interesting that particularly for adult GWSS, when tested against total counts all the methods showed very close results for small experimental trees and commercial-size trees. These methods will continue to be the basis for GWSS population assessment, but some caution should be kept in mind, when drawing conclusions beyond the accuracy of the measurements. In particular, sticky trap data seems to be constrained not only by whether conditions, but also by the traps' insect load, that reduces trap efficiency (see project's last year report). We are seeking to improve our estimations of the methods' accuracy, by including wind speed, temperature, rain and clod cover in a multivariate model.

FUNDING AGENCIES
Funding for this project was provided by the University of California Pierce's Disease Grant Program. This project received a one-year no cost extension, and we will continue to gather the same data through July 2004 to increase the accuracy of these estimations.