SAMPLING, SEASONAL ABUNDANCE, AND COMPARATIVE DISPERSAL OF GLASSY-WINGED SHARPSHOOTERS IN CITRUS AND GRAPES: DISPERSAL PROGRESS REPORT

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INTRODUCTION

Insect dispersal can be influenced by numerous factors, such as increasing population densities, reproductive status, biased sex ratios, host breadth, declining host quality and changing environmental conditions (Denno 1979, 1985; Taylor 1985, Denno et al. 1991, Blackmer and Phelan 1991, Blackmer and Byrne 1993a,b, 1999; Blackmer and Cross 2001). A better understanding of how these various factors influence the movement of the glassy-winged sharpshooter will be crucial in the management of this pest and the spread of Pierce's disease (PD).

OBJECTIVES

1. Compare rates of movement between glassy-winged sharpshooters (GWSS) and native smoke-tree sharpshooters (STSS) to better understand changes in the spread of PD.
2. Correlate the effects of crowding, sex ratio, reproductive status, host-plant quality and environmental variables with population dynamics and movement of GWSS as an aid to predicting insect and disease spread.

RESULTS AND CONCLUSIONS

Mark-release-recapture (MRR) studies with GWSS and STSS were conducted in 2001 in Moreno Valley in an abandoned alfalfa field, and in 2002 additional releases of GWSS were carried out in an 11-ha Valencia orchard in Fillmore, California. Temperature, relative humidity, barometric pressure, wind speed, and wind direction were monitored at the center of each release site with a portable weather station. Physiological parameters, such as egg load, weight and sex ratio were also measured. Recapture data generated from these studies were fit to a diffusion model (Turchin and Thoeny 1993) and model results were used to estimate dispersal distances for each species in each habitat. This model has been shown to accurately describe the movement of numerous insect species (Kareiva 1983, Plant and Cunningham 1991, Turchin and Thoeny 1993, Corbett and Rosenheim 1996, Rudd and McEvoy 1996). At the Fillmore site, sharpshooters were collected and doubly marked with an IgG protein solution (Hagler et al. 1992, Hagler 1997) and a light application of fluorescent pigment. Four colored pigments were used consecutively, which allowed us to separate released sharpshooters from the background population, as well as track sharpshooters for up to 6 wks. Sharpshooters were recaptured on cylindrical yellow sticky traps that were attached at ground, mid-canopy (2-3m) and upper-canopy level (6-7m) to 7-m tall telescoping poles. In a separate study, at the Fillmore location, movement of GWSS was measured relative to time of day, environmental parameters, and xylem flux. Sticky traps were changed and xylem sap was collected at four-hour intervals from 0600 to 2200 hours (N=5).

Linear regressions of recapture data with the diffusion model provided significant fits to the data with high coefficients of determination (R^2) for all of the GWSS and 3 of the 4 STSS releases in 2001, and for 5 of the 6 releases in 2002 (Table 1). In 2001, calculations of dispersal distances using the diffusion model showed that 50 and 95% of the GWSS moved 30 and 90 m in 5-6 hr, respectively, while 50 and 95% of the STSS moved 47 and 155 m, respectively (Table 2). Approximately 7% of the GWSS and 21% of the STSS flew beyond our most distance annuli (90m) in the 2001 releases. In 2002, more than 83,000 GWSS were marked and released between July and early October. Calculations of dispersal distances for these releases showed that 50 and 95% of the GWSS moved 30 and 99 m in 72 hr, respectively (Table 2). Parameters estimated in these trials will be used in further experiments and modeling efforts to determine absolute rates of movement for GWSS.

In separate stepwise regression analyses, trap distance from the release site was the best predictor of trap catch ($R^2 = 0.38$, $P<0.0001$ for GWSS and $R^2 = 0.31$, $P<0.0001$ for STSS in 2001; $R^2 = 0.23$, $P<0.0001$ in 2002). In 2001, the addition of trap height, release date, height and distance interaction accounted for an additional 20-31% of the variability in trap catch. In 2002, the addition of trap height, release date and cardinal position only accounted for an additional 10% of the variability in trap catch. Recapture rates were considerably lower in the citrus orchard as compared to the open field setting (1.6% in 72 hours vs. 12% in 6 hours). Similar to 2001, more sharpshooters were recaptured on the two lower traps (below 3m) than on the upper traps ($P<0.05$) for all six releases in 2002. Egg loads were fairly even in July and August (3.77 ± 0.38; mean ± SD), but declined in September and October to 0.65 ± 0.33 per female. Weights for male and female sharpshooters fluctuated little throughout the study (0.036 ± 0.003 g for females; 0.027 ± 0.002 g for males), even after egg loads declined. A female biased sex ratio (0.72:1.0; male:female) was evident in the first two releases (in July), but thereafter, a male biased sex ratio (1.2:1.0) was observed.

In a separate study, that measured sharpshooter movement relative to time of day, environmental parameters and xylem flux, we found that sharpshooters were most active, in terms of flight activity, between 1000 and 1400 hours (Figure 1). Of the environmental parameters tested, only temperature explained a significant amount of the variability in trap catch in 2002 (R^2 = 0.58, P< 0.0001). Sharpshooters were rarely trapped when temperatures fell below 18°C.

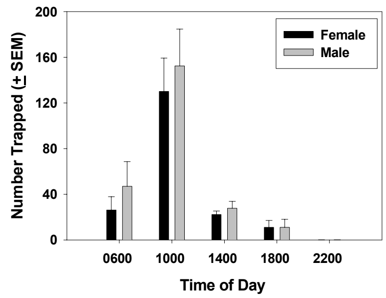

Figure 1. Number of female and male *H. coagulata* trapped relative to time of day.

Table 1. Parameter estimation of diffusion model fit to glassy-winged sharpshooter (GWSS) and smoke tree sharpshooter (STSS) dispersal data for 2001 in Moreno Valley and 2002 in Fillmore, CA.

	GWSS – 2001				STSS – 2001				GWSS - 2002			
	Parameter Estimates											
Trial	*A*	*B*	*P*	R^2	*A*	*B*	*P*	R^2	*A*	*B*	*P*	R^2
1	134.71	26.98	0.022	0.86	27.45	47.71	0.076	0.70	106.27	37.03	0.011	0.69
2	186.42	26.76	0.017	0.89	27.79	48.29	0.002	0.97	108.01	23.05	0.002	0.88
3	60.60	21.65	0.012	0.91	23.27	30.96	0.009	0.92	136.58	26.33	0.009	0.78
4	107.23	25.26	0.014	0.90	32.63	31.88	0.005	0.95	323.32	17.61	0.0001	0.99
5									179.12	23.36	0.002	0.87
6									8.16	40.18	0.21	0.29

.Data for 2001 are recaptures at 6 hour intervals; data for 2002 are recaptures at 72 hr intervals.

Table 2. Estimates of the radius of a circle enclosing various proportions of dispersal distances for GWSS and STSS after point release in an alfalfa field in 2001, and in a mature orange grove in 2002.

Proportion Enclosed	Estimated Radius (m) for GWSS-2001	Estimated Radius (m) for STSS-2001	Estimated Radius (m) for GWSS-2002
0.50	30	47	30
0.67	43	68	44
0.95	90	155	99
0.99	99	220	145

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Use of Pesticides and Alternative Treatments to Control Glassy-winged Sharpshooter and Pierce's Disease