ARE NATURAL ENEMIES CONTROLLING GLASSY-WINGED SHARPSHOOTER POPULATIONS IN SOUTHERN CALIFORNIA?

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ABSTRACT
Considerable effort and expense has been invested in the classical biological control of glassy-winged sharpshooter (GWSS) with natural enemies, in particular, mymarid parasitoids that attack the eggs of GWSS. However, no comprehensive long term studies have been under taken to ascertain why GWSS populations have declined by ~93% over the last 8.5 years. The most probable cause for GWSS population declines are natural enemies, in particular egg parasitoids, with *G. ashmeadi* being the major contributor to GWSS suppression at UCR Ag. Ops. We have documented that natural enemies provide on average year round around egg parasitism of ~25%. A critical question to ask: "Is this sufficient mortality to cause GWSS populations to decline?" Preliminary investigations using very simple models suggest that this consistent level of egg mortality, irrespective of GWSS population density and other mortality factors, may have been sufficient to cause the declines observed in this study.

LAYPERSON SUMMARY
Glassy-winged sharpshooter (GWSS) populations have declined dramatically in southern California over the last 8.5 years. In 2010, average peak population densities of GWSS were only ~7% of what was measured in 2002, indicating that pest populations have declined by around 93%. The major question that needs to be answered from this study is **WHY** has this population decline occurred? If we can figure out the underlying mechanism causing GWSS populations to decrease then we will better understand how stable GWSS populations are likely to be in southern California over the long-term, and perhaps, be able to predict factors and conditions that could lead to GWSS outbreaks. Consequently, the results from these simple surveys could be of immense value to managing GWSS in southern California, especially understanding the contributions of parasitoids that attack the eggs of this pest. This understanding could greatly help agricultural producers that experience problems with this pest (e.g., grape growers) and assist with the development of sustainable management plans.

INTRODUCTION
Homalodisca vitripennis (Hemiptera: Cicadellidae), the glassy-winged sharpshooter (GWSS), and *Xylella fastidiosa (Xf)* have been the target of a major long-term research effort in California because *Xf*, a xylem-limited bacteria which is vectored by GWSS, causes a lethal malady of grapes which is known as Pierce's disease. In an effort to reduce the population densities of GWSS in California, a classical biocontrol program against GWSS was undertaken against the backdrop of an established and self-introduced parasitoid of GWSS eggs, *Gonatocerus ashmeadi* (Hymenoptera: Mymaridae). To measure the impacts of the self-established *G. ashmeadi*, a number of native Californian mymarid and trichogrammatid parasitoids that attacked GWSS eggs, and two deliberately introduced species of *Gonatocerus* from the home range of GWSS, a long-term monitoring study of GWSS and impact these parasitoids attacking GWSS eggs were having was set up and run in organic lemons at the University of California, Riverside. The results of these monitoring studies from the last 8.5 years are presented here.

OBJECTIVES
1. To conduct long-term monitoring of GWSS populations and associated egg parasitoids in organic citrus at the University of California Riverside Agricultural Operations (Ag. Ops) facility. The purpose of these long-term surveys was to document the long-term population trends of GWSS and percentage parasitism of GWSS eggs at this study site. These data will be used to determine which factors are responsible for the year to year variations observed in GWSS densities.

RESULTS AND DISCUSSION
Data collected from bi-weekly monitoring over the last 8.5 years from organic commercially-managed lemons at Ag. Ops. UC Riverside indicates that GWSS populations have declined steadily since this project was initiated in March 2002 (**Figure 1**). Peak population densities in August 2010 were only 7% of those observed in August 2002. In this 8.5 year period, GWSS populations have declined by 93% at the study site (**Figure 1**). It is uncertain whether parasitism of GWSS eggs by mymarid parasitoids is completely responsible for this downward population trend (**Figure 2**), but his possibility seems extremely likely. In California, there is a guild of natural enemies attacking GWSS eggs. The dominant parasitoid attacking GWSS in California is *G. ashmeadi* which was self-introduced into California from the home range of GWSS. Other *Gonatocerus* parasitoids associated with GWSS eggs are *G. morrilli*, *G. walkerjonesi*, *G. novofasciatus, G. triguttatus* and *G. fasciatus*. The latter two, *G. triguttatus* and *G. fasciatus*, were imported from Texas and Louisiana, respectively, for

the classical biological control of GWSS. Widespread establishment of these two parasitoids appears doubtful and their impact on GWSS has been negligible. Trichogrammatid parasitoid species include, *Ufens* sp., and *Zagella* sp. parasitize GWSS eggs infrequently in organic lemons at UCR Ag. Ops. *G. ashmeadi* is the dominant parasitoid at this study site, and it has provided an average of ~25% parasitism of GWSS eggs over the entire ~8.5 yrs that this study site has been monitored (**Figure 2**). It is possible that this consistent year to year level of mortality inflicted upon GWSS eggs (in addition to other mortality factors [e.g., predation and accidental death of nymphs]) by *G. ashmeadi* has caused sufficient population-level mortality that GWSS densities have steadily declined in each year of this study. Rigorous statistical analyses are now required to provide a deeper understanding of the trends in the data that have been recorded and for elucidating mechanisms most likely to be responsible (e.g., parasitism vs. weather patterns). This analysis process has begun and preliminary results from simple modeling efforts suggests that a 25% parasitism rate each year by *G. ashmeadi* could be sufficient to cause GWSS populations to decline at the rate that has been observed at the study site used for field observations.

CONCLUSIONS

GWSS populations have declined by 93% in organic lemons at UC Riverside AG. Ops over the last ~8.5 years. Preliminary analysis of this long term data set suggest that parasitism of GWSS eggs at a rate of 25% each year by the mymarid egg parasitoid *G. ashmeadi* could have been sufficient enough to have caused this decline. More detailed statistical analyses are currently underway to more thoroughly explore the trends observed in this data set.

FUNDING AGENCIES

Funding for this project was provided, in part, by the CDFA Pierce's Disesase and Glassy-winged Sharpshooter Board, and the USDA-funded University of California Pierce's Disease Research Grants Program.

Figure 1. Phenology of adult GWSS in organic Eureka lemons. Data are total counts from timed five minute surveys made every two weeks of 10 mature lemon trees at Ag. Ops. University of California, Riverside.

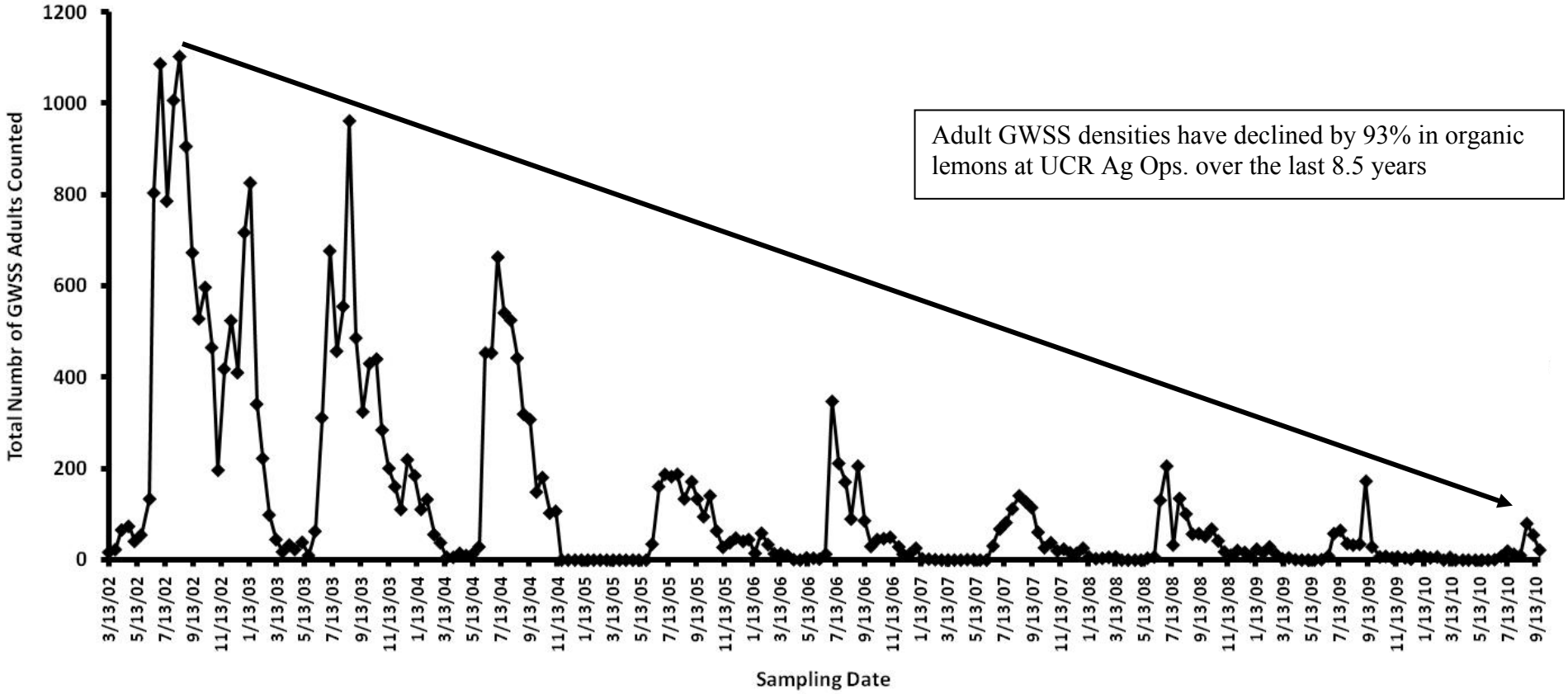
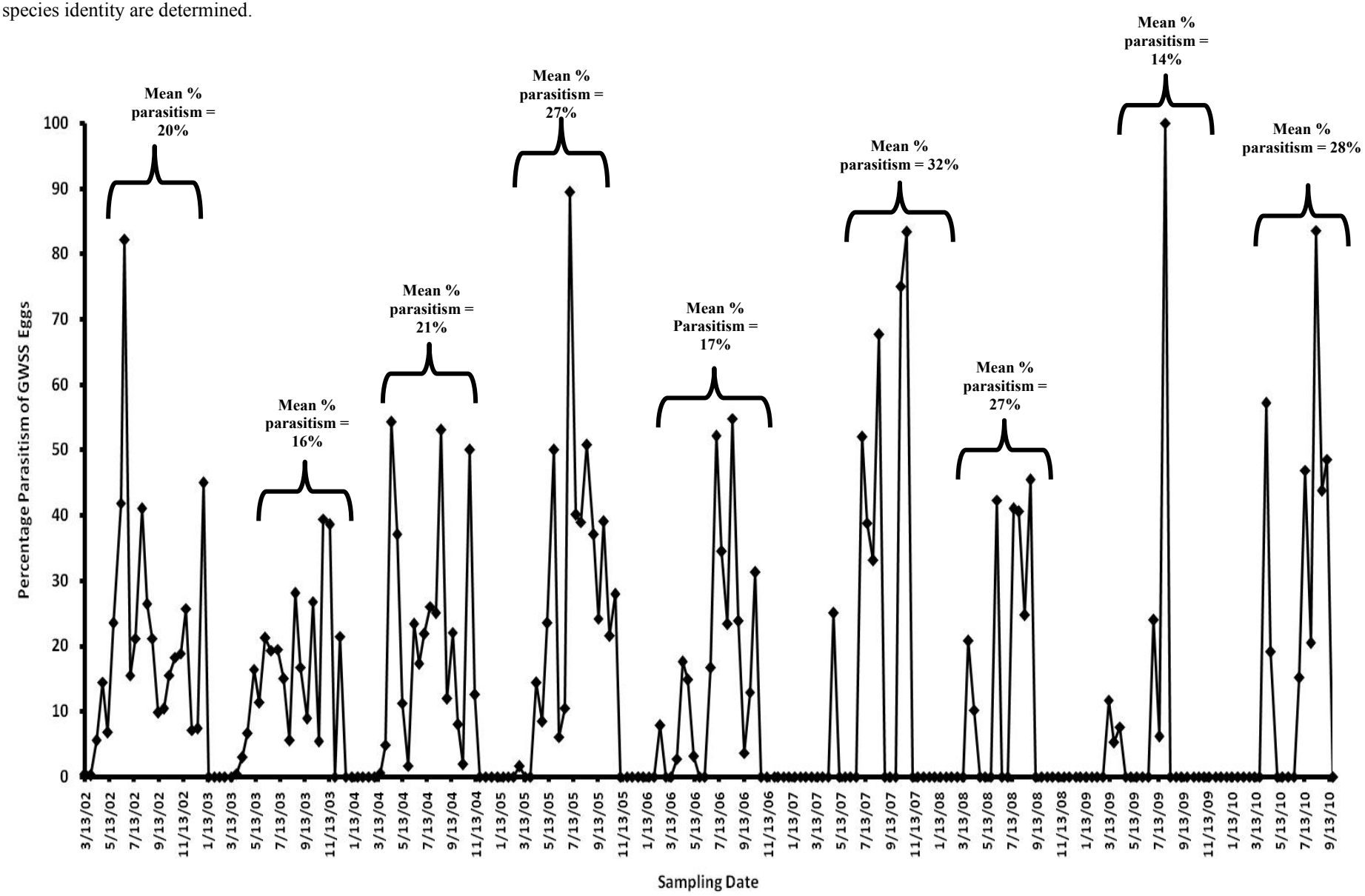


Figure 2. Percentage parasitism estimates of GWSS eggs in Eureka lemons. GWSS egg masses are collected from timed five minute surveys made every two weeks of 10 mature lemon trees at Ag. Ops. University of California, Riverside. Harvested leaves are returned to the laboratory, the number of eggs per egg mass are counted and parasitoid emergence and species identity are determined.



Percentage parasitism of GWSS eggs across all years has averaged ~ 25%