DETERMINING THE DAY-DEGREE REQUIREMENTS FOR GLASSY-WINGED SHARPSHOOTER DEVELOPMENT AND QUANTIFICATION OF DEMOGRAPHIC STATISTICS AT FIVE TEMPERATURES

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ABSTRACT
Glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) developmental and reproductive biology has received very little attention from researchers investigating management strategies for this pest. This is a major impediment to rearing this insect for experimental work, developing management plans, understanding interactions with natural enemies, predicting incursion risk into new areas, and spread in recently inoculated areas. Field-oriented management plans for GWSS, if they are to be effective, need solid data on day-degree accumulations to predict pest developmental times, number of expected generations per year, and estimates of expected longevity and fecundity. The purpose of this grant is to generate these fundamental biological data for GWSS to assist pest management programs, biological control efforts, and incursion risk management. Work investigating the developmental and reproductive biology of GWSS at 20°C and 30°C is underway and should be completed by the end of the year (i.e., December 2006).

INTRODUCTION
Completed studies have comprehensively quantified the day-degree requirements of *Gonatocerus ashmeadi* and its demographic statistics across five temperatures (Pilkington & Hoddle, 2006a). These temperature derived data were modeled and equations generated were put into a GIS model built from 381 weather stations in California (CA). Geographic Information System (GIS) output using temperature data and relationships between *G. ashmeadi* development and population growth predicted the "intensity" of generational turnover and population growth throughout CA for this parasitoid. These results may indicate where *G. ashmeadi* can be expected to invade in California should its host, the glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*), invade these areas too (Pilkington & Hoddle, 2006b). Similar work has been completed and submitted for publication on *G. trigutattus* (Pilkington & Hoddle, 2006c, d). However, these analyses for parasitoids and GIS application are moot unless they can be overlaid and compared with similar predictions for GWSS from comparably generated and analyzed data on its developmental and reproductive biology. Consequently, the intent of this project is to develop estimates of reproductive output at five different temperatures, and time to complete development at these experimental temperatures. Together these data will enable GIS modeling to predict incursion risk and intensity of population growth of GWSS in different areas of California and these models can be compared to similar data and GIS models for *G. ashmeadi* and *G. triguttatus*.

OBJECTIVES
1. Develop day-degree models for GWSS by quantifying the developmental biology at 5 different temperatures (15, 20, 25, 30, & 33°C).
2. Quantify reproductive biology and generate demographic statistics from $l_x m_x$ life tables at five experimental temperatures.
3. Use day-degree data (Objective 1) and demographic estimates (Objective 2) in GIS to predict the geographic range of GWSS within California, and intensity of population turnover in areas vulnerable to incursion. These predictions will be compared to those generated for two egg parasitoids of GWSS, *G. ashmeadi* and *G. triguttatus*.

RESULTS
This work is ongoing and results for 20°C and 30°C are not yet available but work should be completed by the end of 2006 for these two temperatures.

CONCLUSIONS
This work is ongoing and will be completed by the next PD Symposium in 2007.

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SHOULD NEOCLASSICAL BIOLOGICAL CONTROL AGENTS FROM ARGENTINA BE RELEASED IN CALIFORNIA FOR CONTROL OF THE GLASSY-WINGED SHARPSHOOTER?

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ABSTRACT
Gonatocerus tuberculifemur and *G*. sp. 6. *morrilli* complex are two sharpshooter parasitoids from Argentina that have been held at the UC Riverside I & Q facility since September 2002 and reared on glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) egg masses. There is substantial uncertainty about the safety of releasing these agents and whether they would provide additional control of GWSS in California or disrupt the efficacy of the existing parasitoid complex which has been constructed with natural enemies that have evolved to exploit GWSS. The purpose of this grant is to ascertain in Quarantine whether these two neoclassical biological control agents from Argentina can outperform the dominant GWSS parasitoid in California, *G. ashmeadi*. These data will help guide the decision to release the Argentinean parasitoids from quarantine for liberation and establishment in California. Work has not commenced on this project as the quarantine colony was recently infused with "new blood" from specimens collected in Argentina in August 2006.

INTRODUCTION
Neoclassical or new association biological control is the deliberate establishment of natural enemies against a target pest with which these natural enemies have no evolutionary history. The intent of this form of inoculative biological control is to suppress target pest populations by creating novel pest-natural enemy associations. The rationale for this strategy is the development of new exploiter-victim relationships which are hypothesized to be more effective at controlling pests. Greater impact can occur because new association avoids using old association co-evolved natural enemies that have developed population stabilizing mechanisms with the pest. It is proposed that old associations potentially result in higher population equilibrium densities compared to what would be observed if a novel efficacious natural enemy was attacking the pest with which there is no evolutionary history (Hokkanen and Pimental, 1984; 1989). Neoclassical biological control is considered to be the least ethically defensible course of action when considering use of natural enemies for pest control because of: (i) uncertainty over adverse effects of novel associations on pest population dynamics, and (ii) potential loss of ecological functions of native species because of non-target attacks (Ehler, 2000). However, these potential concerns should be addressed on a case by case basis, rather than relying on broad generalizations that ranks the ethical desirability of employing new associations lower than old associations, and the environmental risk factor substantially higher. Survey work by the USDA in Argentina has revealed a complex of parasitoid species attacking Proconiini [this is the same tribe that the glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) belongs to] sharpshooters in South America. Some of these discovered species are new to science, and two species, *Gonatocerus tuberculifemur* and *G*. sp. 6, from Argentina have been in quarantine at UC Riverside since September 2002. These two parasitoids dominated the natural enemy fauna attacking Proconiini cicadellids in arid areas of Argentina (i.e., provinces of Mendoza and Rio Colorado) and it is thought that they may be well suited to California's climate and could provide substantial control of GWSS. Limited work on host specificity testing conducted by the CDFA suggests that native California non-Proconiini sharpshooters are not at substantial risk from non-target attacks by *G. tuberculifemur* (Pickett pers. comm. 2005). However, all native U.S. Proconiini sharpshooters are considered to be at high risk of attack by these Argentinean parasitoids (Goolsby pers. comm. 2005). Consequently, concerns have been raised about non-target impacts on native USA Proconiini sharpshooters that could result from establishing these Argentinean parasitoids in California. The most salient risk scenario is the successful incursion of native GWSS habitat in the southeast USA and northeast Mexico by these neoclassical biological control agents from Argentina. This could readily occur via the transportation of plant material from California to Florida that carries GWSS egg masses parasitized by *G. tuberculifemur* or *G*. sp. 6. Should this occur, potential impact on native southeastern USA Proconiini sharpshooters is almost certain to occur, but the magnitude of the severity of successful infiltration is impossible to predict *a priori*. Consequently, the purpose of this research project is to determine if the neoclassical biological control agent, *G. tuberculifemur*, is competitively superior to the omnipresent *G. ashmeadi*, and exhibits the potential to be an extremely aggressive and efficacious natural enemy that can dominate the system to the almost total exclusion of all current parasitoids thus providing higher levels of biological control of GWSS than is currently observed.