Determining Fecundity and Longevity for the Invasive Goldspotted Oak Borer (*Agrilus auroguttatus* Schaeffer) (Coleoptera: Buprestidae)

Vanessa Lopez[1] and Mark Hoddle[1,2]

[1]Department of Entomology, University of California Riverside,
[2] Center for Invasive Species Research, University of California, Riverside

ABSTRACT

Fecundity and longevity studies were conducted in quarantine with adult goldspotted oak borers (GSOB) collected from San Diego County, California. The realized lifetime female fecundity was determined from GSOB females provided with food, water, and either limited or unlimited access to males for mating. Adult longevity and size was recorded for male and female GSOB provided with food, water, and mates. The goal of this work was to quantify the number of eggs that females are capable of producing over their lifetimes, hatch rates for laid eggs, and to determine whether non-continuous access to females by males had an effect on female fecundity and on male and female longevity. This information is the first basic life history data to be recorded for this pest. Results could be used for developing rearing systems for this pest and for models attempting to estimate GSOB population growth and potential spread throughout California.

INTRODUCTION

The goldspotted oak borer (GSOB), *Agrilus auroguttatus*, (Fig. 1) is a buprestid beetle native to oak woodlands in southeastern Arizona and northern Mexico. The GSOB introduction into southern California (CA) has caused widespread mortality to three species of native California oaks. Since 2002, tree mortality from *A. auroguttatus* has been estimated at >21,500 trees (Coleman and Seybold 2011), and oak mortality (Fig. 2) is increasing rapidly as GSOB populations build and this pest spreads. Almost no information is available on the biology or life history of *A. auroguttatus*. Quantifying basic life history traits for this invasive beetle is essential for predicting the population dynamics of *A. auroguttatus*. This information may also facilitate the development of a rearing system for GSOB which would enable the development and rearing of natural enemies for use in a classical biological control program against this pest.

Figure 1. The goldspotted oak borer, *Agrilus auroguttatus.*

Figure 2. Oak mortality in the Cleveland National Forest.

METHODOLOGY

Collection Methods:

GSOB were collected from 28 rearing tents (Fig. 3), which were set-up at the Camp Ole Fire Station in the Cleveland National Forest in San Diego County, Southern CA (Fig. 4). These tents were loaded with GSOB infested oak logs. Tents were checked daily once GSOB emergence began, and live adults were transported under permit (CDFA Permit No. = 2664; USDA-APHIS permit No. = P526P-10-00667) to the Insectary and Quarantine Facility at the University of California, Riverside for use in the studies reported here.

Figure 3. Rearing tents set-up at the Camp Ole Fire Station in the Cleveland National Forest, San Diego County, California.

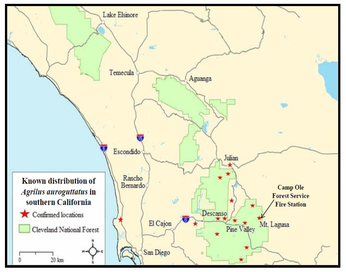

Figure 4. Distribution of *Agrilus auroguttatus* in southern California (modified from Coleman and Seybold 2008).

Experimental Design:

In quarantine, newly emerged females (<24 hours old) were placed with either one newly emerged male (treatment 1) or two newly emerged males (treatment 2) into a rearing container (Fig. 5). Adults were provided oak leaves, water, and coffee filter paper for oviposition (Fig. 6). After 10 days, males from treatment 1 were removed from their rearing containers, placed in a separate rearing cage, and provided with food and water until death. Males from treatment 2 remained with their respective females until death. Male and female longevity was checked daily for both treatments, and the size of males and females from both treatments was determined by measuring elytron width. Realized fecundity was determined by counting the number of eggs laid inside each rearing container approximately every 14 days, and summing these egg totals across the entire egg laying interval and lifespan of females. The eggs oviposited inside each rearing container were removed after they were counted and placed in a separate container until larval hatching was complete. Percentage egg hatch was calculated by counting the number of larval emergence holes and expressing it as a percentage of the total number of eggs laid inside each container.

Figure 5. Rearing containers with GSOB provided with oak leaves, water, and coffee filter paper as an oviposition substrate.

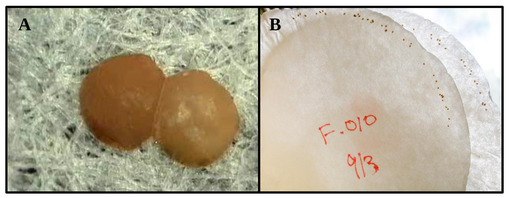

Figure 6. GSOB eggs (A) which were oviposited onto coffee filter paper (B) placed inside ventilated plastic containers (see Fig. 4).

RESULTS & DISCUSSION

On average, the total number of eggs oviposited from females in treatment 1 (n = 52) was (Mean ± SE) 49.71 ± 7.35. Females from treatment 2 (n = 59) oviposited on average 51.33 ± 9.71 eggs. The total number of larvae hatched from females in treatments 1 and 2 was 2,089 (82% hatched) and 2,584 (87% hatched), respectively. The average fecundity and total number of larvae hatched from females in treatments 1 and 2 were not statistically different (t = -0.68, df = 50, P >0.05) and (t = 1.69, df = 34, P >0.05) respectively. Therefore, females who had experienced non-continuous access to males were capable of laying the same number of eggs and larvae as females who were provided continuous access to males throughout their lifetime. This suggests that access to multiple mates for female GSOB over their lifetime may not be necessary to realize their maximum egg laying. Similarly, egg hatching rates (a measure of egg quality) was not influenced by continuous access to males. The pattern of female fecundity (Fig. 7) is shown in approximately 14 day intervals from females across all treatments. Fecundity appears to be low initially, and begins to increase until late August. After reaching a peak for all treatment types, fecundity decreases in September.

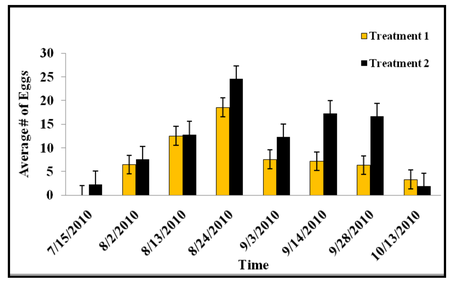

Figure 7. Mean (± standard error) female fecundity from all treatment types over approx. 14 day intervals.

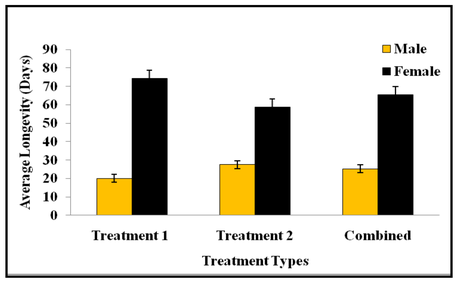

Figure 8. Mean (± standard error) longevity of males and females from all treatment types.

Adult longevity was recorded for male and female GSOB for both treatments (Fig. 8). Males from treatments 1 (n = 46) and 2 (n = 112) lived an average of 20.09 ± 2.31 and 23.24 ± 1.39 days, respectively. Females from treatments 1 (n = 38) and 2 (n = 33) lived an average of 71.13 ± 3.49 and 58.88 ± 4.17 days, respectively. A two-way ANOVA on longevity versus treatment type and gender showed a significant interaction between treatment type and gender (F = 8.09, df = 1, 128, P <0.01). Females from all treatment types had significantly higher adult longevity when compared to the males from their respective treatments (t = -13.08, df = 70, P <0.01). Females with more mating opportunities (treatment 2) had decreased longevity in comparison to females in treatment 1 (t = 3.29, df = 32, P <0.01), where access to males was eliminated after 10 days. Additionally, regression analyses on adult longevity and size showed an increase in male and female longevity with an increase in elytron width (R^2 = 0.3469, P < 0.01).

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LITERATURE CITED

Coleman, T. W. and S. J. Seybold. 2008. New pest in California: The goldspotted oak borer, *Agrilus coxalis* Waterhouse. *USDA Forest Service, Pest Alert*, R5-RP-022, October 28, 2008, 4 pp.

Coleman, T. W. and S. J. Seybold. 2011. Collection history and comparison of the interactions of the goldspotted oak borer, *Agrilus auroguttatus* Schaeffer (Coleoptera: Buprestidae), with host oaks in southern California and southeastern Arizona. *The Coleopterists Bulletin* (in press).