Verification of a useful character for separating the sexes of the goldspotted oak borer, *Agrilus coxalis auroguttatus* (Coleoptera: Buprestidae)

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Scientific Note

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The goldspotted oak borer, *Agrilus coxalis auroguttatus* Schaeffer (Coleoptera: Buprestidae), is a new threat to several native oak species in California (CA) (Coleman & Seybold 2008a, b). The beetle larvae feed in and damage the outer xylem, cambium, and phloem of coast live oak, *Quercus agrifolia* Née (Fagaceae), California black oak, *Q. kelloggii* Newb., and canyon live oak, *Q. chrysolepis* Liebm., killing these trees after several years of repeated injury. Infested trees can be identified by crown thinning and dieback, D-shaped adult emergence holes primarily on the main stem, and dark black or deep red staining on the bark exterior resulting from the wound response to the extensive larval feeding. The first record of *A. c. auroguttatus* in CA is from 2004 (Westcott 2005), but the species was first linked with continuing tree mortality in CA in June 2008 (Coleman & Seybold 2008a, b). The invasive CA population is hypothesized to have been introduced from Arizona (AZ) during the mid- to late 1990s, most likely on firewood (Coleman & Seybold 2009, 2010). In support of this, the CA and AZ populations are considered to have identical subspecific status (Hespenheide & Bellamy 2009). The nominate subspecies, *Agrilus coxalis coxalis* Waterhouse, is considered native to southern Mexico and northern Central America (Hespenheide & Bellamy 2009).

Agrilus c. auroguttatus continues to cause mortality in San Diego Co., CA. In 2009, aerial survey data provided an estimate of 2,800 new oaks killed by *A. c. auroguttatus*, bringing the cumulative total of dead oaks to $>$ 20,000 since 2002. As of October 2009, the zone of infestation is estimated at 4900 km^2. Due to the economic and ecological impact of this new non-native species in CA, studies have been initiated to determine its life history, to enhance survey and monitoring methods, and to assess management options. One key feature necessary to facilitate this work in the laboratory and field is the capacity to accurately distinguish the sexes of *A. c. auroguttatus*.

In the original species description of *A. c. coxalis*, Waterhouse (1889) did not mention any diagnostic external morphological characters for the males or females. However, in the description of *A. c. auroguttatus* (then *A. auroguttatus*), Schaeffer (1905) noted the similarity of the male and female, but that the male was ''smaller, more slender, and has a faint longitudinal impression on the first and second ventral segments. The division between the first and second ventral segments is indicated in some specimens by an impression on each side and a smooth transverse line at the middle, in others it is hardly visible.'' Earlier, this median groove on the first and second ventral segments of the abdomen had been reported in a variety of males in the genus *Agrilus* (Horn 1891), and then given as a generic character by Fisher (1928), who wrote that ''males of some species have a longitudinal vitta of long, white hairs on the first and second segments, and the surface is longitudinally depressed.'' Because of the extreme importance of *A. c. auroguttatus* to forest

resources, we decided to photodocument, further describe, and confirm this character to facilitate future research and detection survey efforts.

Between May and October, 2009, we collected adult *A. c. auroguttatus* from purple or lime-green prism flight intercept traps placed at six sites within the infested area on the Cleveland National Forest (San Diego Co., CA). The traps were hung between 1.5 and 4.5 m above the forest floor. In May 2009, we collected pre-pupae of *A. c. auroguttatus* in the bark of Emory oak, *Q. emoryi* Torrey, from the Coronado National Forest (Pima Co., AZ). Adults were reared in the lab from the bark samples.

Initial observations were conducted on several specimens (~ 20), which were dissected to confirm the sex associated with any morphological differences. These initial observations revealed that males have a ventral triangular depression on the posterior portion of the first abdominal ventrite (Figs. 1, 2). The indention lacks pubescence, which is ubiquitous on the abdominal venter of both sexes. The depression, or groove, in the male is shallow and approximately 1.01 ± 0.02 mm (mean ± SE) in length (n = 50). Evidence of this character is also apparent on the second abdominal ventrite where the absence of pubescence along the midline is visible, but the feature is more anterior on this ventrite and lacks a depression. This character can be seen easily with 10× magnification. The first abdominal ventrite of males is also slightly constricted when viewed ventrally and concave when viewed laterally.

An additional 100 adults were collected from CA by the same trapping methods and were first separated based on the character on the male abdominal venter. To verify each sex, the genitalia were exposed by separating the distal abdominal sclerites with an insect pin. Due to the limited number of adults collected in AZ in 2009 only 30 individuals were assessed and verified for the external sexually dimorphic feature. Male and female body lengths were measured prior to dissections.

Identification of each sex with the key diagnostic character yielded 100% accuracy. The median ventral depression on males was effective at separating both sexes and is easy to observe and allowed us to separate the sexes rapidly and with great accuracy Males are generally shorter than females [8.9 ± 0.08 mm for males; 9.9 ± 0.08 mm for females (mean ± SE), (n = 100)]. At the widest point of the abdomen (near the posterior end of the first ventrite), females (2.5 ± 0.10 mm, n = 5) are wider than males (2.1 ± 0.04 mm, n = 14). The sclerotized male genitalia are dark brown in color at the posterior end and lighter brown at the basal portion. The posterior end of the male genitalia is sculpted with numerous punctures and hairs on the lateral edge on the dorsal side.

The sexual dimorphism that we have documented for *A. c. auroguttatus* will be a useful character to help us conduct future laboratory and field research. In CA, *A. c. auroguttatus* is currently causing the most mortality to oaks of any insect (Geiger & Woods 2009). This species has the potential to impact 1.5 million ha of susceptible host type in CA (Gaman & Firman 2006).

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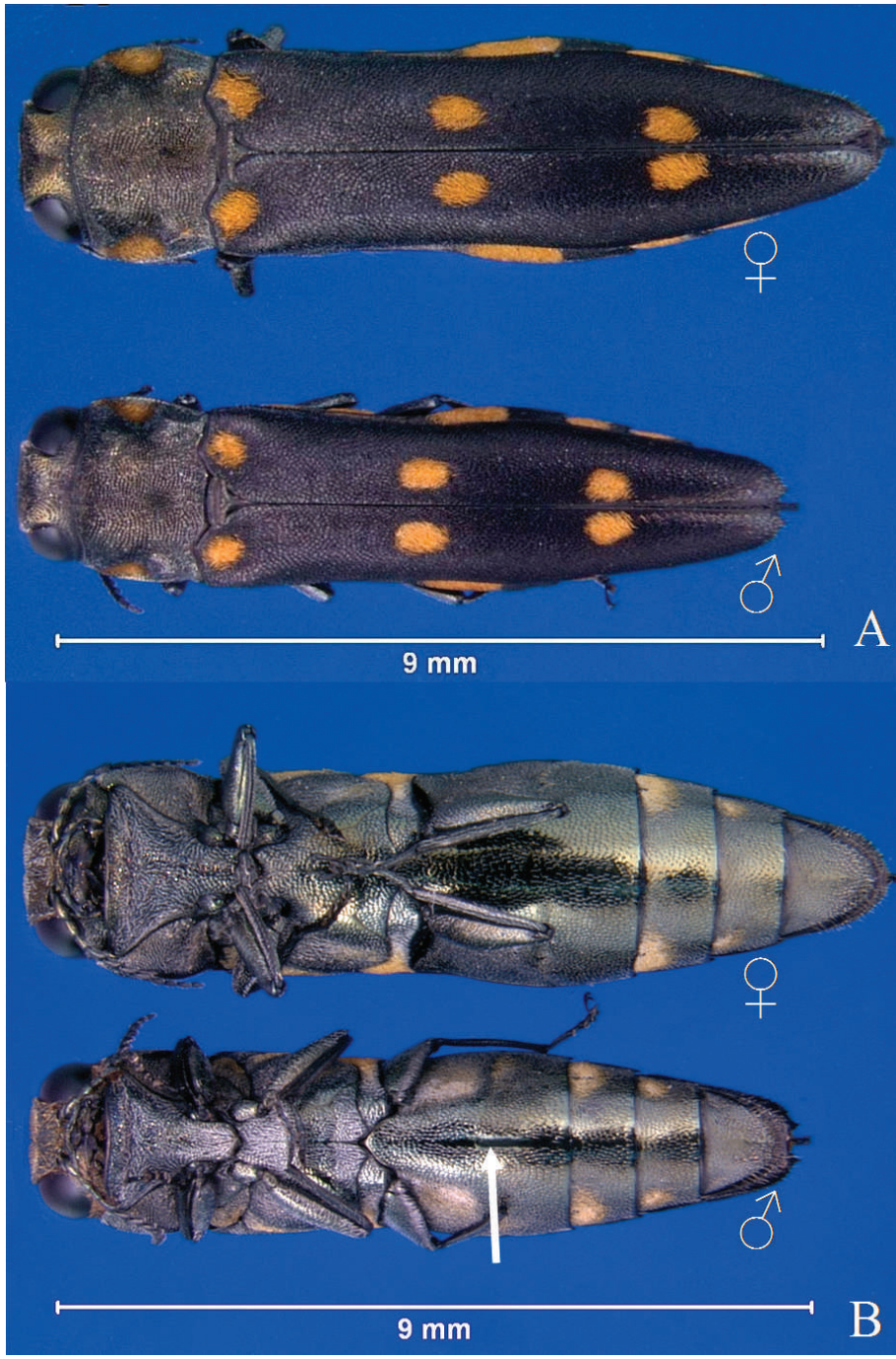

Figure 1. Dorsal (A) and ventral (B) views of the female (top) and male (bottom) goldspotted oak borer, *Agrilus coxalis auroguttatus*. The distinguishing triangular indention on the males is located along the ventral midline of first abdominal segment (S. Blomquist photos).

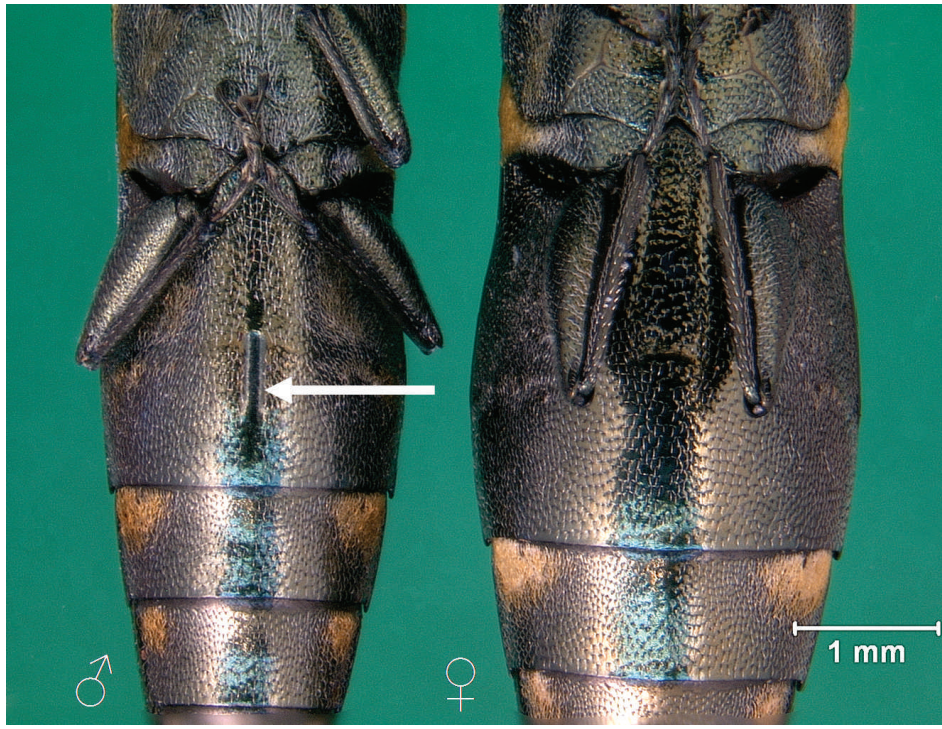

Figure 2. Close-up of the male (left) and female (right) first abdominal ventrites of the goldspotted oak borer, *Agrilus coxalis auroguttatus*, male and female (S. Blomquist photos).

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Literature Cited

Coleman, T. W. & S. J. Seybold. 2008a. 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. & S. J. Seybold. 2008b. Previously unrecorded damage to oak, *Quercus* spp., in southern California by the goldspotted oak borer, *Agrilus coxalis* Waterhouse (Coleoptera: Buprestidae). *The Pan-Pacific Entomologist* 84:288–300.

Coleman, T. W. & S. J. Seybold. 2009. Striking gold in southern California: Discovery of the goldspotted oak borer and its central role in oak mortality, pp. 12–16. *In*: K. A. McManus & K. W. Gottschalk (Eds.). Proceedings. 20th U.S. Department of Agriculture Interagency

Research Forum on Gypsy Moth and Other Invasive Species 2009, January 13–16, 2009, Annapolis, Maryland; Gen. Tech. Rep. NRS-P-51. USDA Forest Service, Northern Research Station, Newtown Square, Pennsylvania, December 2009, 114 pp.

Coleman, T. W. & S. J. Seybold. 2010. GSOB ≠ SOD: Tree mortality from the goldspotted oak borer in oak woodlands of southern California, pp. 58–63. *In*: S. J. Frankel, J. T. Kliejunas & K. M. Palmieri (Eds.). Proceedings. Fourth Sudden Oak Death Science Symposium, June 15–18, 2009, Santa Cruz, California; Gen. Tech. Rep. PSW-GTR-229. USDA Forest Service, Pacific Southwest Research Station, Albany, California, April 2010, 378 pp.

Fisher, W. S. 1928. *A revision of the North American species of buprestid beetles belonging to the genus Agrilus*. Smithsonian Institution, United States National Museum, Bulletin 145, pp. 1–347.

Gaman, T. & J. Firman. 2006. *Oaks 2040: The status and future of oaks in California*. Produced for the California Oak Foundation, Inverness, California, pp. 1–55.

Geiger, J. & M. Woods (compilers). 2009. California forest pest conditions—2008. California Forest Pest Council, California Department of Forestry and Fire Protection, Sacramento, California, June, 2009, pp. 1–65.

Hespenheide, H. A. & C. L. Bellamy. 2009. New species, taxonomic notes, and records for *Agrilus* Curtis (Coleoptera: Buprestidae) of México and the United States. *Zootaxa* 2084:50–68.

Horn, G. H. 1891. The species of *Agrilus* of boreal America. *Transactions of the American Entomological Society* 18:277–336.

Schaeffer, C. 1905. Some additional new genera and species of Coleoptera found within the limit of the United States. *Museum of the Booklyn Institute of Arts and Sciences, Science Bulletin* 1(7):141–179.

Waterhouse, C. O. 1889. *Insecta. Coleoptera. Serricornia.* 62. *Agrilus coxalis. Biologia Centrali-Americana*, Vol. III, Pt. 1, April 1889, pp. 1–89.

Westcott, R. L. 2005. A new species of *Chrysobothris* Eschscholtz from Oregon and Washington, with notes on other Buprestidae (Coleoptera) occurring in the United States and Canada. *Zootaxa* 1044:1–15.

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