

New State Record and DNA Barcode Information for *Philolema latrodecti* (Hymenoptera: Eurytomidae) in Georgia¹

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Spiders play an essential role in controlling insect populations in both agricultural and urban environments (Nyffeler et al. 1988, J. Appl. Entomol. 106: 52–57; Shochat et al. 2004, Ecol. Appl. 14: 268–280). Widow spiders (genus *Latrodectus*) are also of medical importance because of the potential health risks associated with their bites (Rohou et al. 2007, Toxicon 49: 531–549; Vetter and Isbister 2008, Annu. Rev. Entomol. 53: 409–429). Although fatalities are rare, neurotoxic venom can lead to severe symptoms including muscle cramps, abdominal pain, nausea, and vomiting (Shackleford et al. 2015, J. La. State Med. Soc. 167: 74–78). Our understanding of widow spider natural enemies and their role in population control is incomplete. The most common parasitoids are in the orders Hymenoptera and Diptera (Dippenaar-Schoeman et al. 2015, Trans. R. Soc. S. Afr. 70: 3; Taucare-Rios et al. 2018, Arachnology 17: 334–336).

Five recognized species of *Latrodectus* (Araneae: Theridiidae) inhabit North America. Four species are native: northern black widow (*L. variolus* Walckenaer), red widow (*L. bishopi* Kaston), southern black widow (*L. mactans* [F.]), and western black widow (*L. hesperus* Chamberlin & Ivie). One *Latrodectus* species is introduced: brown widow (*L. geometricus* C.L. Koch) (Platnick 2009, The World Spider Catalog, Version 9.5. American Museum of Natural History, New York, NY; Schraft et al. 2021, Arachnology 18: 783–802). In Georgia, the brown widow and southern black widow are common (Sadir and Marske 2021, Front. Ecol. Evol. 9: 757902), but the northern black widow exists in much smaller numbers and only in the northern part of the state (Sadir and Marske 2021; Wang et al. 2018, PLoS One 13: e0201094).

The brown widow is a widespread synanthropic species (Brown et al. 2008, J. Econ. Entomol. 45: 959–962; Garb et al. 2004, Mol. Phylogenet. Evol. 31: 1127–

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1142). African in origin but first described from South America, the brown widow can now be found on all continents except Antarctica (Garb et al. 2004; Levi 1959, Trans. Am. Microsc. Soc. 78: 7–43). In the United States, this spider originally became established in Florida in the 1930s, underwent rapid expansion in the 1990s, and today is found throughout the southeastern United States, southern California, and Arizona (Sadir and Marske 2021; Vincent et al. 2008, Pan-Pac. Entomol. 84: 344–349).

The native southern black widow is found throughout the southeastern United States, although it has been found as far north as Ohio and as far west as Texas (Sadir and Marske 2021). In addition to producing smooth egg sacs (in contrast to the spikey egg sacs of the brown widow), the southern black widow has a lower reproductive rate, producing fewer egg sacs with a longer incubation period (Cottichio et al. 2023, Ann. Entomol. Soc. Am. 116: 174–183). Brown widows also prey upon black widows and may be a factor contributing to local extinctions and displacement from their native habitat (Cottichio et al. 2023).

Several egg predators and parasitoids are known to prey upon widow spiders (Triana et al. 2012, Arachnology 15: 293–298; Vetter et al. 2012, J. Arachnol. 40: 209–214). *Latrodectus* species are also differentially susceptible to parasitism (Mowery et al. 2023, Oecologia 202: 143–150). The chloropid fly *Pseudogaurax signatus* (Loew) is the most common egg parasitoid of the brown widow and western black widow in California and preys on all species of *Latrodectus* in the United States (Vetter et al. 2012). *Baeus latrodecti* (Dozier) and *Gelis* sp. were the most common parasitoid wasps of the brown and western black widows in California, and both wasps prey on the southern black widow (Vetter et al. 2012). Other wasp egg parasitoids that prey on the brown widow include *Pediobius pyrgo* (Walker), *Philolema abalosi* De Santis, and *Philolema arachnovora* (Hesser) (Dippenaar-Schoeman et al. 2015, Taucare-Rios et al. 2018). One species, *Philolema* (= *Eurytoma*) (= *Desantisca*) *latrodecti* (Fullaway) (Hymenoptera: Chalcidoidea), parasitizes brown and black widow eggs (Fullaway 1953, Proc. Hawaii. Entomol. Soc. 15: 33–36). It was originally described from brown widow egg sacs in Hawaii (Fullaway 1953) and occurs in Florida (Brambila and Evans 2001, Insecta Mundi 15: 18), but its distribution throughout the rest of the United States is currently unknown.

Here we report the first known occurrence of *P. latrodecti* in the state of Georgia. Adult parasitoids emerged from brown and black widow egg sacs collected in southern Georgia. This parasitoid was first found by us in 2009 and has been found each successive year. Thus, we can confidently state that they are established in the state. The following material was examined (all adults):

1. 18 individuals: Garden City, GA (32.121200, –81.170175); brown widow egg sac;
2. 13 individuals: Statesboro, GA (32.426268, –81.780885); brown widow egg sac;
3. 43 individuals: Statesboro, GA (32.449607, –81.787295); brown widow egg sac;
4. 4 individuals: Statesboro, GA (32.451388, –81.771500); brown widow egg sac;
5. 5 individuals: Statesboro, GA (32.355536, –81.854581); southern black widow egg sac.

Morphologically, the specimens are consistent with the description provided by Fullaway (1953). To confirm the morphological identifications, a genetic analysis was undertaken. DNA was extracted from individual wasps with the DNeasy Blood and Tissue Kit (Qiagen, Germantown, MD) following the manufacturer's protocol. The DNA was used to amplify a 710-bp portion of the mitochondrial cytochrome oxidase I (COI) gene by polymerase chain reaction (PCR) using the primers LCO1490 (5'-GGTCAACAAATCATAAAGATAT TGG-3') and HCO2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3') (Folmer et al. 1994, Mol. Mar. Biol. Biotechnol. 3: 294–299). These primers amplify the COI barcoding region used for arthropod taxa in public databases (Ratnasingham and Hebert 2007, Mol. Ecol. Notes 7: 355–364).

The PCR products were purified for sequencing with exonuclease I and shrimp alkaline phosphatase. Fragments were sequenced by using the LCO1490 or HCO2198 primer used for amplification. Cycle sequencing was performed with the Big Dye Terminator Kit, version 3.1 (Applied Biosystems, Thermo Fisher Scientific Corporation, Waltham, MA), and sequencing products were separated on an ABI 3500 Genetic Analyzer (Applied Biosystems).

Sequences were edited and aligned with Sequencher 4.10 (Gene Codes Corporation, Ann Arbor, MI). The edited sequences were submitted to a BLAST search in GenBank and the Barcode of Life Data system to find the closest species match (Ratnasingham and Hebert 2007).

Wasps from brown widow egg sacs had COI sequences identical to those from southern black widow egg sacs, indicating that a single wasp species is parasitizing both widow species in Georgia. These sequences also had 99–100% identity with unassembled sequences from a *P. latrodecti* genome sequence available in GenBank (Bioproject PRJNA811764, Biosamples SAMN26355859 and SRA SRX14526793). The next closest matches in the GenBank or BOLD databases were several *Eurytoma* species at 89–90% sequence identity. Voucher specimens have been placed in the Georgia Southern University entomology collection.

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