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A NEW LEAFMINING MOTH (*CAMERARIA COTINIVORA*, LEPIDOPTERA: GRACILLARIIDAE) OF THE AMERICAN SMOKETREE (*COTINUS OBOVATUS*)

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Abstract.—Fieldwork in the Ozark Mountains of the central United States by GRG over the last decade involving the American smoketree, *Cotinus obovatus* Raf. (Anacardiaceae), has resulted in the discovery of a previously unknown moth species belonging to the genus *Cameraria* (Lepidoptera: Gracillariidae). The larva of this species mines the leaf mesophyll of this tree, creating serpentine mines most visible from the upper (adaxial) surface of the leaf. The most closely related species to *Cameraria cotinivora*, n. sp. is *Cameraria guttifinitella* (Clemens), a common leafminer of poison ivy, *Toxicodendron radicans* (L.) Kuntze (Anacardiaceae). Illustrations of both species are provided as well as a COI analysis of their genetic relationship.

Key Words: American smoketree, *Cameraria cotinivora*, *Cameraria guttifinitella*, *Cotinus obovatus*, Gracillariidae, leafminer, taxonomy

DOI: 10.4289/0013-8797.118.2.244

With the discovery of *C. cotinivora*, the predominantly Nearctic genus *Cameraria* currently includes 54 species known to range over most of North America and southern Canada, with several species yet to be described. Fewer than 30 species have been reported from the Old World, i.e., the Oriental, Palearctic, and Afrotropical regions (De Prins & De Prins 2015). Adult *Cameraria* are usually characterized by reddish to orange brown forewings, often with 2-3 white fasciae with external margins bordered by black scales. The eighth abdominal sternite of the male is enlarged and highly modified, usually extending part way beneath the genitalia, as often in the genus *Phyllonorycter*.

American smoketree (*Cotinus obovatus* Raf., Anacardiaceae, Fig. 8) is a rare North American shrub or small tree known from three disjunct populations

(Fig. 1) in south-central Texas, on the Ozark Plateau in Arkansas, Missouri, and Oklahoma, and from the southern Cumberland Plateau in northeastern Alabama and adjacent Tennessee and Georgia (Little 1977). Few specimens have trunk diameters exceeding 30 cm or have canopy heights greater than 12 m (mature trees usually range between 4-6 m in height). The simple ovate leaves (8-15 cm) have entire margins and long petioles. The plants are usually dioecious with small flowers in loose panicles that appear in April and May. Flower pedicels elongate after flowering, and those on abortive flowers become plumose which lends a smoky appearance to the tree when viewed from a distance. The dark yellow wood was used sporadically in the 19th century as a source of fustic dye and for fence posts owing to its resistance to decay. All known populations occur on soils derived from calcareous bedrock, typically in glades and on cliffs and bluffs. They occur less frequently in mixed hardwood-cedar woodland. American smoketree is only occasionally cultivated as an ornamental, as most gardeners prefer its showier relative, the European smoketree (*Cotinus coggygria* Scop.), which ranges from southern Europe eastward across central Asia to northern China.

For more than a decade GRG has been engaged in a general survey of *Cotinus obovatus* in order to better define its geographic range and to collect genetic samples from populations on the Ozark Plateau and on the southern Cumberland Plateau. It was also suspected that the relative rarity and the highly fragmented geographic range of the plant might reveal some interesting relationships among the insect herbivores. Thus far only specimens of *C. cotinivora* have been found mining the leaves, but some disjunct populations of the plant have not been examined thoroughly.

The European smoketree is chemically protected (Fraternale & Ricci 2014) and the same is likely true for the poorly studied but closely related American smoketree (Miller et al. 2001). The only recorded native herbivore of the American smoketree is a notodontid moth, *Datana perspicua* Grote and Robinson (Crocker & Simpson 1982). Documentation of native communities of phytophagous insects that feed on the American smoketree is of particular interest given the tree's rarity and its fragmented natural geographic range. The proposed introduction of biocontrol agents to counter the invasive Brazilian pepper-tree (*Schinus terebinthifolia* Raddi, Anacardiaceae) in Florida (Medal et al. 1999, Manrique et al. 2008) may pose a conservation risk to the distantly related American Smoketree. Thus there is an urgent need for immediate taxonomic identification of all native and introduced herbivores of the American Smoketree.

GRG first encountered gracillariid leaf mines in populations of the American smoketree on the Ozark Plateau while mapping the geographic distribution of the host. Here we report that this leafminer represents a new species of *Cameraria* (Lepidoptera: Gracillariidae), most closely related to *Cameraria guttifinitella*, a common leafminer of poison ivy, Anacardiaceae, *Toxicodendron radicans* (L.) Kuntze. *Cameraria guttifinitella* has also been reared from *Rhus aromatica* Aiton in Canada by T. N. Freeman and E. van Nieukerken.

Materials and Methods

Specimens examined in this study are deposited in the former United States National Museum (USNM), now the National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

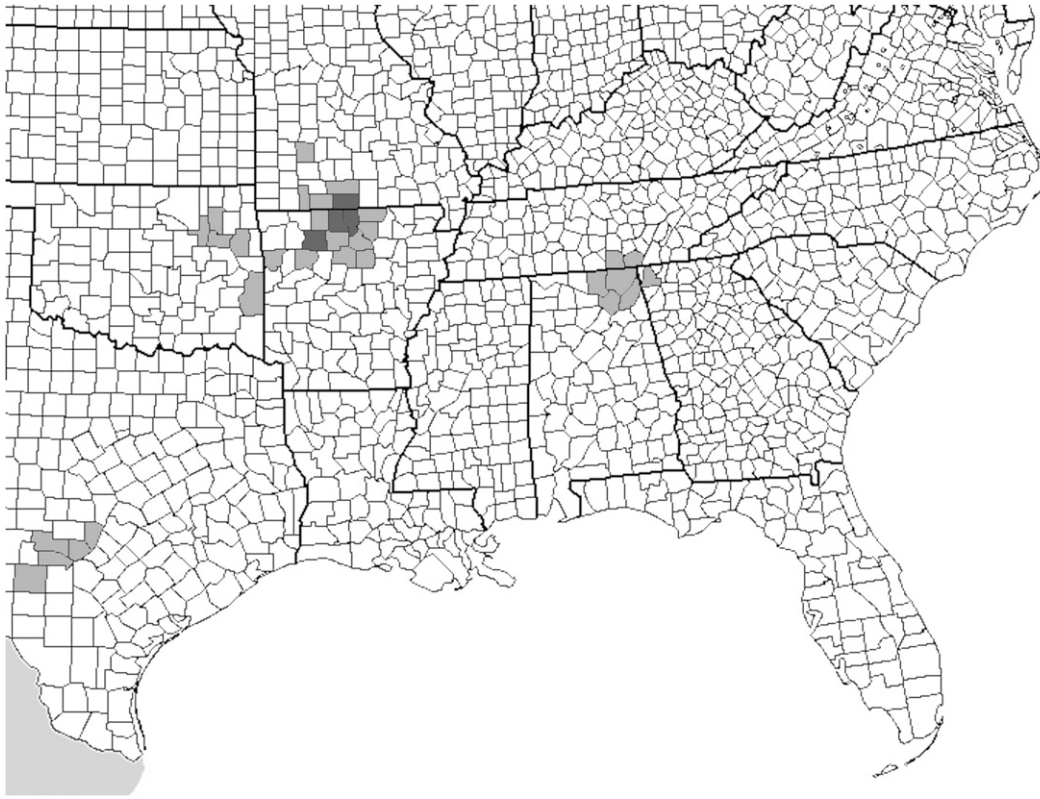

Fig. 1. Distribution of *Cotinus obovatus* (light gray) and of *Cameraria cotinivora* (dark gray).

Specimen preparation: Genitalic dissections were cleared by heating in hot 10% KOH for ~ 30 minutes, and subsequently cleaned and stained with either 2% chlorazol black E or mercurochrome solutions. Genitalic illustrations were drawn from dissections temporarily stored in glycerine, which were later permanently embedded in Canada balsam. Genitalic terminology follows Klots (1970) and Kristensen (2003). Sequences of the 658bp mitochrondrial cytochrome oxidase subunit I gene (CO1) were generated at the Biodiversity Institute of Ontario, University of Guelph, Canada and the Naturalis Biodiversity Center, Leiden, the Netherlands. DNA was extracted from legs using a QIAGEN DNeasy Extraction Kit (Oiagen, Inc., Valencia, CA), or from abdomens and larvae using the procedures discussed in Nieulerken *et al.* 2012. Primers LepF1 and LepR1 (Hebert *et al.* 2004), or the list of primers shown in Table 1 of Nieulerken *et al*, 2012, were used to obtain the barcoding fragment of COI following methods previously described (Hajibabaei *et al.* 2006, Nieulerken *et al.* 2012). Sequences are available in GenBank (http://www.nchi.nlm.nih.gov/genbank/) and BOLD (http://www.boldsystems.org/index.php/) databases. A neighbor-joining (NJ) tree was generated from nucleotide sequences using the BOLD aligner as implemented in BOLD (Ratnasingham and Hebert, 2007, 2013). Phylogenetic and molecular evolutionary analyses were conducted

Table 1. Sample information for specimens submitted for COI barcoding. Additional specimen data as well as sequence data are available on the BOLD website at RDOPO Basal Lepidoptera.

Sample ID	Species of *Cameraria*	Locality	BOLD Process ID	GenBank Accession Number
USNMENT00656313	*cotinivora*	USA: Missouri; Ozark County, County Road 514	MNAM083-10	JF858636
USNMENT00656311	*cotinivora*	USA: Arkansas; Newton County, Erbie Campground Road	MNAM081-10	KU380344
USNMENT00656308	*cotinivora*	USA: Arkansas; Newton County, Erbie Campground Road USA: Arkansas	MNAM078-10	JF858633
USNMENT00656312	*cotinivora*	USA: Arkansas; Newton County, Erbie Campground Road USA: Arkansas	MNAM082-10	JF858635
USNMENT00656309	*cotinivora*	USA: Arkansas: Baxter County, Denton Ferry Road	MNAM079-10	JF858634
BIOUG01927-C03	*guttifinitella*	USA: Arkansas; Perry County, Toad Suck Ferry Park	BBLOE920-12	KU380340
RMNH.INS.552280	*guttifinitella*	USA: North Carolina: Haywood County; Great Smoky Mountains National Park	WOGRA022-13	KU380343
DNA-ATBI-5043	*guttifinitella*	USA: Tennessee, Blount County	LGSME043-06	KU380341
CLV291011	*guttifinitella*	USA: Washington D.C.	GRPAL657-11	KU380339
RMNH.INS.552279	*guttifinitella*	USA: North Carolina	WOGRA021-13	KU380345
RMNH.INS.30477	*guttifinitella*	USA: Virginia	WOGRA130-15	KU380342

using MEGA version 6 (Tamura *et al.* 2013).

Results

Cameraria cotinivora Davis and Graves, new species

Figs. 1–2, Figs. 4, Figs. 6, Figs. 9–11

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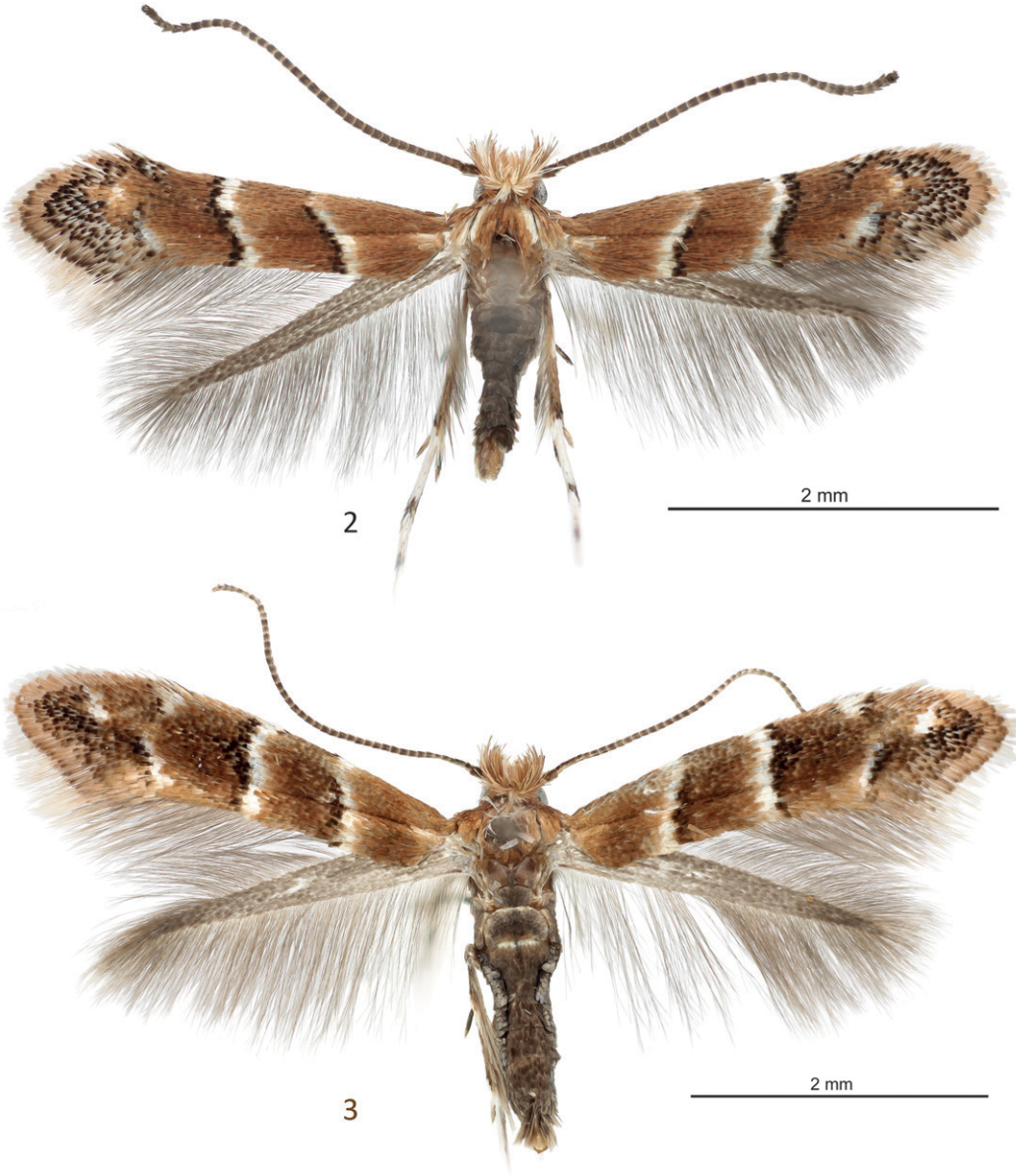
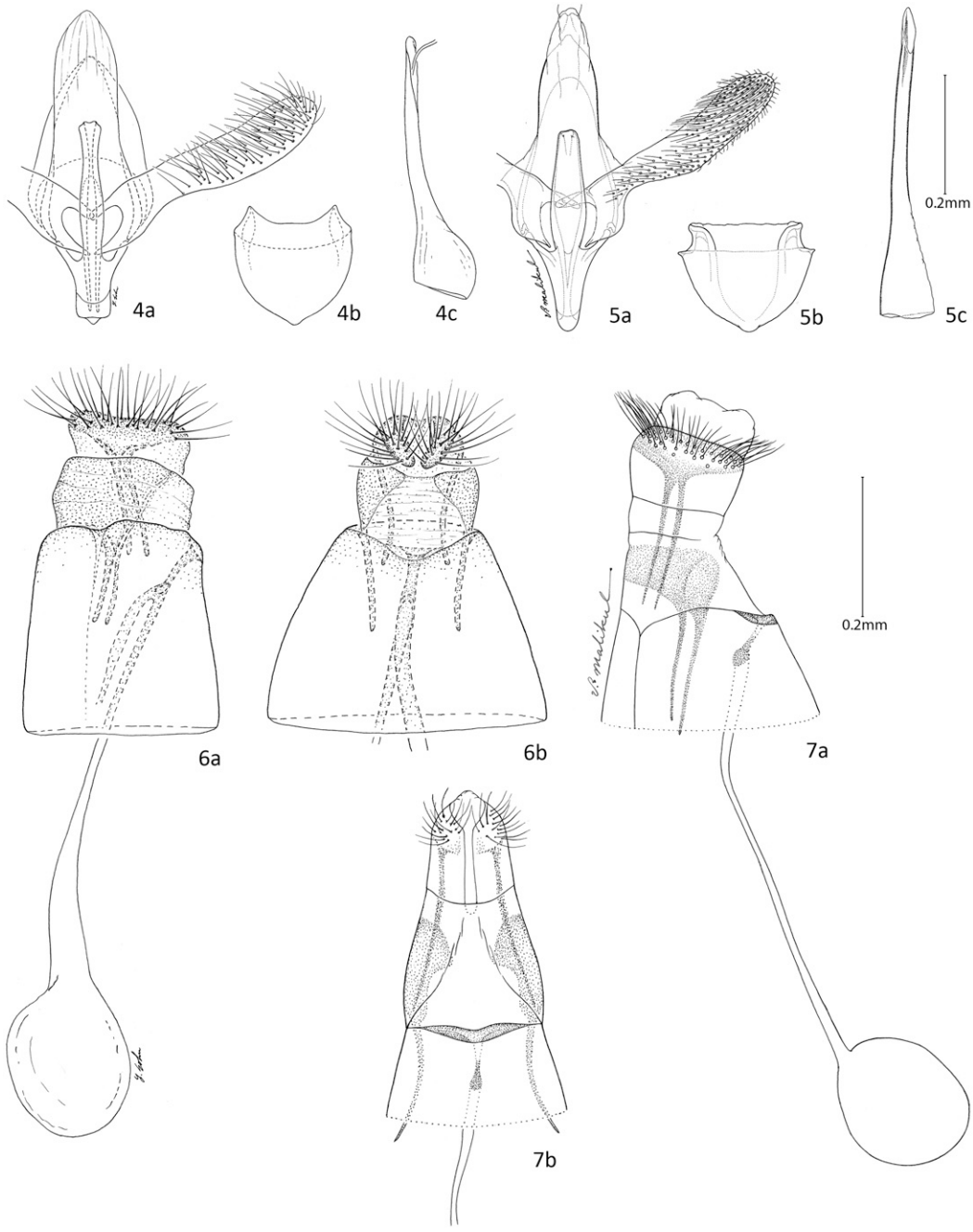
Diagnoses.—*Cameraria cotinivora* is most similar, both morphologically and genetically, to *Cameraria guttifinitella* (Figs. 3, 5, 7), a common leafminer of another North American member of the plant family Anacardiaceae, *Toxicodendron radicans*. They are the only known North American *Cameraria* known to feed on Anacardiaceae. The forewings of both species possess a pair of prominent white fasciae that are bordered externally by black scales, a pattern (Figs. 2–3) similar in several species of North American *Cameraria*. The subapical fascia, although incomplete, is more preserved in *C. guttifinitella* (Fig. 3) and the apical white spot is more distinct than in *C. cotinivora* (Fig. 2). The valva of the male genitalia of *C. cotinivora* (Fig. 4a) differs from that of *guttifinitella* (Fig. 5a) in the sacculus being less pronounced (less constricted distally). The saccus of *cotinivora* is also more truncate, the base of the phallus is more swollen, and the vincular process and anellus are more slender than in *guttifinitella.* In the female genitalia both the anterior and posterior apophyses are relatively shorter in *cotinivora* (Fig. 6a) than in *guttifinitella* Fig. 7a), and the caudal margin of the eighth sternite is less sclerotized in *cotinivora*. A neighbor-joining tree of the genetic distances for



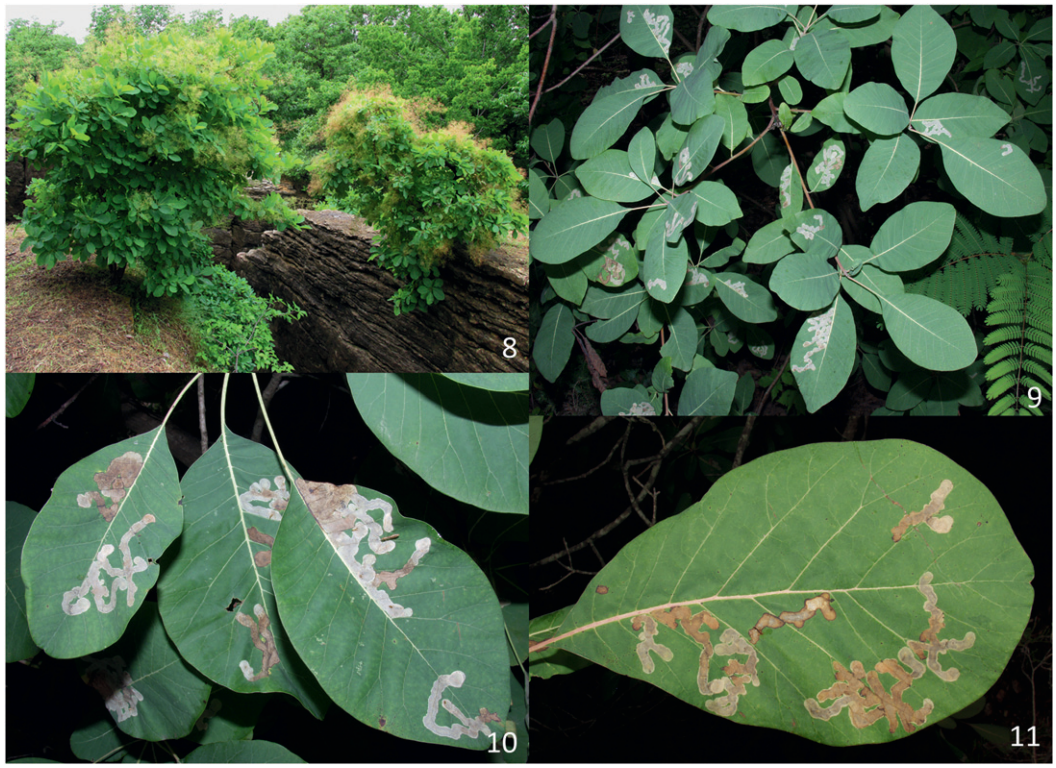
Figs. 2–3. Adults. Scale = 2 mm. 2. *Cameraria cotinivora*. Holotype ♂. 3. *Cameraria guttifinitella* ♀, Piscataway National Park, Prince Georges County, Maryland.

cytochrome c oxidase I (COI) computed by the Biodiversity Institute of Ontario, University of Guelph, Canada for *Cameraria cotinivora* and *C. guttifinitella* revealed a divergence of ~ 4% (Fig. 12).

Description.—Adult (Fig. 2). Forewing length 2.4–3.0 mm. *Head*: Frons smooth, with broad, silvery white scales; vertex rough, with long, white piliform scales partially intermixed below with similar light reddish brown, piliform scales; scales of vertex directed somewhat forward as a pair of short, lateral tufts; a faint band of reddish brown



Figs. 4–7. Genitalia. Scale = 0.2 mm. 4. Male, *Cameraria cotinivora*. 4a. Ventral view, USNM slide 33848. 4b. Eighth sternite, ventral view. 4c. Phallus, lateral view. 5. Male, *Cameraria guttifinitella*. 5a. Ventral view, USNM slides 17071, 17076. 5b. Eighth sternite, ventral view. 5c. Phallus, lateral view. Figs. 6 – 7. Female, 6. *Cameraria cotinivora*. 6a. Lateral view USNM slide 33850. 6b. Ventral view. 7. Female, 7. *Cameraria guttifinitella*. 7a. Lateral view, USNM slide 18306. 7b. Ventral view.



Figs. 8–11. 8. *Cotinus obovatus* Raf. Tulsa County, Oklahoma. 9 - 11. Leafmines of *Cameraria cotinivora* on *Cotinus obovatus*. Baxter County, Arkansas, (photographed 29 July 2006).

piliform scales extending above frons between antennal bases. Antenna ~ 0.83x the length of forewing; flagellomeres smoothly scaled, white ventrally, dark fuscous dorsally with paler scale bases. Labial palpus straight, directed ventrad, and covered with silvery white, smooth scales; apical segment with a few black scales. *Thorax*: Pronotum and tegula light reddish brown with a pair of relatively broad bands of white scales diverging from head caudally across tips of tegulae. Venter of thorax mostly white. Forewing mostly light reddish brown with two slender, prominent, slightly curved, white fascia extending diagonally across basal third and just beyond middle of wing; outer margins of fasciae bordered with black scales; subapical region of forewing complex, mostly covered by black scales with white bases; subapical fascia poorly developed, with only a portion near dorsal edge of wing evident; black tipped scales around apex of wing with broad, pale brownish bases that form a subapical band around wing tip; fringe yellowish white around apex of wing, pale grayish white and longer along dorsal margin. Hindwing uniformly light gray. Foreleg mostly black dorsally and white ventrally; tarsomeres with two white annuli; midleg mostly white with dorsal black spot at base of femur, three dorsal black spots on tibia and two dorsal black areas on tarsus; hindleg mostly white with two small black spots on femur; apical half of tibia mostly dark brown to fuscous and tarsus with two black annuli. *Abdomen*: Brownish fuscous dorsally and laterally, white ventrally. Eighth sternite of male

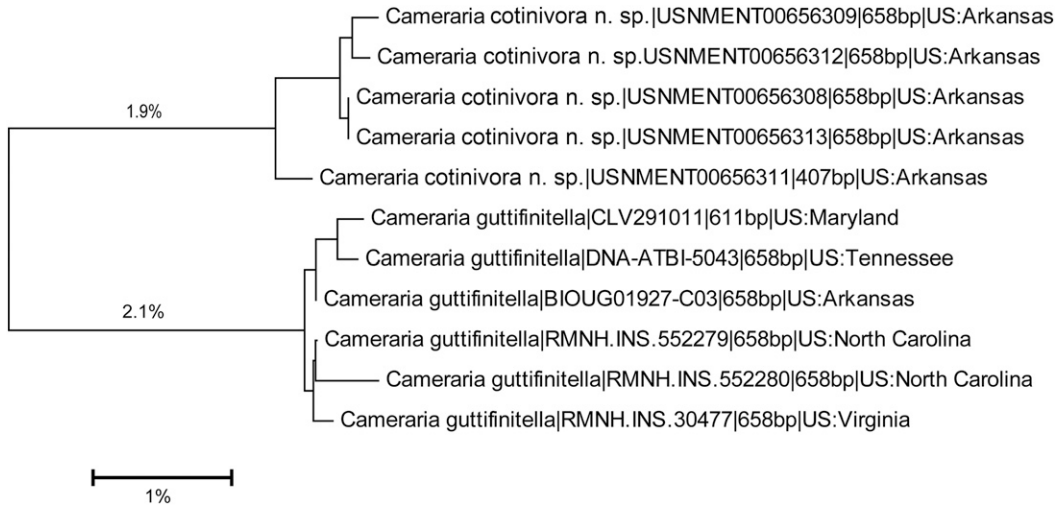


Fig. 12. Neighbor-joining tree of genetic distances (K2P model) for cytochrome c oxidase I (COI) for *Cameraria cotinivora* and *Cameraria guttifinitella*. End-branch labels are specimen Sample IDs, followed by the sequence length, and geographic origin.

(Fig. 4c) generally triangular, approximately as long as broad when flattened. *Male genitalia* (Figs. 4a–c): Tegumen moderately elongate, ~ 0.7x length of valva, triangular with semi-acute, tapering apex. Valva elongate, slender with evenly rounded apex; a slight, smoothly curved constriction present immediately distad of sacculus. Vinculum-saccus shorter than eighth sternite, with mostly truncate anterior apex; caudal medial extension of vinculum (vincular process) long and slender, ~ 0.5x the length of valva. Phallus slender, ~ equal to length of valva, and with swollen base ~ 4.5x width of phallus at midlength. *Female genitalia* (Figs. 6a-b): Anterior apophysis ~ 0.83x length of posterior apophysis. Ostium a simple, slightly enlarged opening at caudal edge of eighth sternum. Ductus bursae elongate, ~ 4.3x length of posterior apophysis, gradually enlarging to ~ spherical corpus bursae; signum absent; duct of accessory bursae arising near caudal end of ductus bursae just before ostium.

Host: Anacardiaceae: *Cotinus obovatus* Rafinesque (American smoketree).

Larval mines (Figs. 9 - 11): The feeding by the larvae of *Cameraria cotinivora* create serpentine mines most visible from the upper (adaxial) surface of the leaf. The early subepidermal sapfeeding mine is usually obliterated by the later broader, full depth serpentine mine. The latter mines are moderately broadly tubular and are of approximately similar width throughout most of their length. Pupation occurs in a loose cocoon at the distal, sometimes slightly enlarged, rounded, terminal end of the mine.

HOLOTYPE: UNITED STATES: ARKANSAS: Baxter Co: Denton Ferry Rd: 36º21.00'N, 92º31.79'W: ♂, 29 Jun 2008, Gary R. Graves; Host: DRD 2685, *Cotinus obovatus* Raf,; Digital image, (USNM holotype 01066895).

PARATYPES: Described from a total of 16♂ and 26♀. UNITED STATES: ARKANSAS: Baxter Co: Denton Ferry Rd: 36º21.00'N, 92º31.79'W: 4♂, 6♀, 29 Jun 2008, em. 4-14 Jul 2008, Host: DRD 2681, *Cotinus obovatus* Raf., 2♂, 1♀, em. 16-24 Jul 2008; 1♀, em. 4-14 Jul, BOLD DNA 00656311; 1♀, em. 15 Jul

2008, BOLD DNA 00656312; 2♀, em. 16-24 Jul, BOLD DNA 00656309, 00656310; 36º21.22'N, 92º31.61'W: 2♂, 3♀, em. 15 Jul 2008; 1♀, 4-9 Jul 2008; Marion Co: Marion County Road 7033: 36º15.13′N, 92º32.42′W: 1♂, 4 Jul 2007, Host: DRD 2668, *Cotinus obovatus* Raf., em. 7 Jul 2007, USNM slide 33848; Host: DRD 2668: *Cotinus obovatus* Raf, 1♀, em. 7 Jul 2007, USNM slide 33850; 2♀, em. 10 Jul 2007, 1♀, em. 22 Jul 2007, Host: DRD 2669: *Cotinus obovatus* Raf,, 1♀, em. 12 Jul 2007; Host: DRD 2670: *Cotinus obovatus* Raf,, 1♂, em. 19 Jul 2007, Gary R. Graves; Newton Co; Erbie Campground Rd, 36º 04.19'N, 93º12.65'W, 26 Jun 2008, Host: DRD 2682: *Cotinus obovatus* Raf, 1♂, 8-10 Jul 2008; 1♂, 1♀, em. 10 Jul 2008; Host DRD: 2681: 1♀, 16-24 Jul 2008, BOLD DNA 00656308, Gary R. Graves. Missouri: Ozark Co: Ozark County Road 514: 36º32.12'N, 92º26.18'W: 1♂, 23 Jun 2007, em.19 Jul 2007, Host DRD : *Cotinus obovatus* Raf, 29 Jun 2008, Host: DRD 2684: *Cotinus obovatus* Raf, 1♀, em. 15 Jul 2008, BOLD DNA 00656313, Gary R. Graves; 36º31.99'N, 92º25.88'W: 29 Jun 2008, Host: DRD 2683: *Cotinus obovatus* Raf, 1♂, 1♀, em. 4-10 Jul 2008; 36º32.12'N, 92º26.18'W: 29 Jun 2008, Host: DRD 2684: *Cotinus obovatus* Raf, 1♂, 2♀, em. 4-14 Jul 2008, Gary R. Graves. (USNM).

Distribution (Fig. 1).—Currently known from Baxter, Marion, and Newton counties in north- central Arkansas and Ozark county in south-central Missouri.

Etymology.—The specific name, *cotinivora*, is derived from the generic plant of the plant host (*Cotinus*) and the Latin *vora* (eat, devour).

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Literature Cited

Braun, A. F. 1908. Revision of the North American species of the genus *Lithocolletis* Hübner. Transactions of the American Entomological Society 34: 269–357, plates 20–24.

Crocker, R. L. and B. J. Simpson. 1982. *Datana perspicua* (Lepidoptera: Notodontidae) attacks *Cotinus obovatus*, a native wood ornamental. Florida Entomologist 65: 375–376.

Davis, D.R. 1983. Gracillariidae, pp. 2–11. *In* R.W. Hodges et al. (Eds.). Check List of the Lepidoptera of America North of Mexico. E.W. Classey Ltd. and the Wedge Entomological Research Foundation, London.

Davis, D. R. 1987. Gracillariidae, pp. 372–374, 376–378. *In* F.W. Stehr (Ed.). Immature insects, Volume 1, Kendall/Hunt Publ. Co., Dubuque, Iowa.

Davis, D. R., F. McKay, O. Marina, D. V. Marcelo, and G. S. Wheeler. 2011. Biology and systematics of the leafmining Gracillariidae of Brazilian pepper tree, *Schinus terebinthifolius* Raddi, with descriptions of a new genus and four new species (Lepidoptera). Journal of the Lepidopterists' Society 65(2): 61–93.

De Prins, J. and W. De Prins. 2015. Global Taxonomic Database of Gracillariidae (Lepidoptera). http://www.gracillariidae.net [accessed 4 August 2015].

Fraternale, D. and D. Ricci. 2014. Chemical composition and antimicrobial activity of the essential oil of *Cotinus coggrgria* Scop. from Italy. Journal of Essential Oil Bearing Plants 17: 366–370.

Klots, A. B. 1970. Lepidoptera, pp. 115–130. *In* S. L. Tuxen, (Ed.). Taxonomist's glossary of genitalia in insects. Munksgaard, Copenhagen.

Kristensen, N. P. 2003. Skeleton and muscles: adults, pp. 39–131. *In* N. P. Kristensen (Ed). Lepidoptera, moths and butterflies. Volume 2: Evolution, systematics, and biogeography. Handbook of Zoology IV (35). Walter de Gruyter, Berlin, New York,.

Little, E. L. 1977. Atlas of United States trees. Volume 4. Minor eastern hardwoods. Miscellaneous Publication No. 1342. United States Department of Agriculture, Washington, D.C., pp.

Manrique, V., J. P. Cuda, W. A. Overholt, D. A. Williams & G. S. Wheeler. 2008. Effect of host-plant genotypes on the performance of three candidate biological control agents of *Schinus terebinthifolius* in Florida.–Biological Control 47:167–171.

Medal, J. C., M. D. Vitorino, D. H. Habeck, J. L. Gillmore, J. H. Pedrosa & L. P. De Sousa. 1999. Host specificity of *Heteroperreyia hubrichi* Malaise (Hymenoptera: Pergidae), a potential biological control agent of Brazilian peppertree (*Schinus terebinthifolius* Raddi).–Biological Control 14:60–65.

Miller, A. J., D. A. Young & J. Wen. 2001. Phylogeny and biogeography of *Rhus* (Anacardiaceae) based on ITS sequence data.–International Journal of Plant Science 162:1401–1407.

Nieukerken, E. J. van, C. Doorenweerd, F. R. Stokvis, D. S.J. Groenenberg. 2012. DNA barcoding of the leaf-mining moth subgenus *Ectoedemia* s. str. (Lepidoptera: Nepticulidae) with COI and EF1-α: two are better than one in recognising cryptic species. Contributions to Zoology, 81(1) 1–24.

Ratnasingham S., and P.D.N. Hebert. 2007. BOLD: The Barcoding of Life Data System (http://www.barcodinglife.org). Molecular Ecology Notes 7(3):355–364.

Ratnasingham S., and P.D.N. Hebert. 2013. A DNA-Based Registry for All Animal Species: The Barcode Index Number (BIN) System. PloS ONE 8(7):e66213.

Tamura K., G. Stecher, D. Peterson, A. Filipski, and S. Kumar. 2013. MEGA6: Molecular Evolutionary Genetics Analysis version 6.0. Molecular Biology and Evolution 30: 2725–2729.