A New Species of *Catocala* (Lepidoptera: Noctuidae) from the Gulf Coast of the Florida Panhandle

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Abstract

A new species of underwing moth, *Catocala slotteni* sp. nov., is described from three specimens from the Gulf Coast of the Florida Panhandle, USA. Corresponding characters from wing pattern, male genitalia and the 5′ region of Cytochrome Oxidase Subunit I mitochondrial DNA separate *C. slotteni* from phenotypically similar species in the genus.

Keywords

Amorpha, mitochondrial DNA, genitalia, new species, underwing moth

Introduction

During May of 2002 and 2004, Jeff Slotten collected three unusual *Catocala* specimens in Gulf County, Florida, USA, that seemed somewhat intermediate in appearance between *Catocala whitneyi,* Dodge and *C. abbreviatella,* Grote. Analyses of wing pattern, male genitalia and mitochondrial DNA (Cytochrome Oxidase Subunit I [COI] 5′) indicate these Floridian specimens represent a new species, which we describe below as *C. slotteni*. Both *C. whitneyi* and *C. abbreviatella* occur in midwestern prairies in North America, where the larvae have been found on *Amorpha canescens,* Pursh (Borth and Barina 1991), whereas the new species was collected in coastal dune and swale system habitats that are highly disjunct from the geographic distributions of *C. abbreviatella*, *C. whitneyi* and *Amorpha canescens.*

The new species belongs to a group of four other closely related species herein referred to as the *Catocala nuptialis* species group, which includes *Catocala nuptialis,* Walker, *C. amestris,* Strecker, *C. whitneyi* and *C. abbreviatella.* Within this group there is high structural homogeneity, and the species cannot be distinguished by genitalic characters except for the three-dimensional structure of the everted vesica. Examples of synapomorphies for this species group include: a contrasting black band bordering the dorsal forewing antemedial line on the distal side; a black patch inside the dorsal forewing reniform spot; vesica diverticulum 1 tetralobal with a prominent subdiverticulum 1d; vesica diverticulum 7 with four distinct lobes on the dorsal side; anterior margin of sternal lobes fairly straight to shallowly triangular across ventral midline (this and the following homoplastic character state also occur in *C. benjamini,* Brower, *C. californiensis,* Brower and their close relatives); anterior dip of anterior margin of sternal lobes across the antrum shallow, much wider than deep; and posterior section of corpus bursae (with minute inverted teeth) angled roughly 45° to the left of the anterior section (with longitudinal wrinkles) in ventral aspect (this homoplastic state also occurs in *C. messalina,* Guenée and *C. aholibah,* Strecker).

Materials and Methods

Methods for data analysis, genitalic dissection by H. L. Kons, Jr. (HLK) and terminology follow Kons and Borth (2015) and as described online (Lepidoptera Biodiversity, LLC 2014). Cytochrome Oxidase Subunit I sequencing was conducted by Paul Hebert's lab at the University of

Guelph as described in Hebert et al. (2003). *Catocala slotteni* specimens studied are from the Division of Entomology of the Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA (YPM ENT), and the private collections of Jeff Slotten, Gainesville, Florida, USA (JS), and Robert J. Borth, Milwaukee, Wisconsin, USA (RJB). We examined *Catocala* from the following additional institutional collections but found no *C. slotteni*: Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania, USA (ANSP); American Museum of Natural History, New York, New York, USA (AMNH); Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA (CMNH); Field Museum of Natural History, Chicago, Illinois, USA (FMNH); McGuire Center for Lepidoptera Research, Gainesville, Florida, USA (MGC); Milwaukee Public Museum, Milwaukee, Wisconsin, USA (MPM); Mississippi Entomological Museum, Mississippi State University, Mississippi State, Mississippi, USA (MEM); National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM); University of California, Riverside, California, USA (UCR); University of Kentucky, Lexington, Kentucky, USA (UK); University of Wisconsin–Madison, Madison, Wisconsin, USA (UW).

Taxonomy

Catocala slotteni, Kons and Borth, sp. nov.
Figure 1 (adults),
Figures 2, 3 and 4 (structures)

Type material.

Holotype. Male, dissection no. 2014HLK:2076, Florida, USA, Gulf Co., vicinity of St. Joe Buffer off Hwy 30A, sandy habitat with *Amorpha herbacea* and oak, 29.69°N, 85.30°W, 2 m, 15 May 2004, UV Trap, J. Slotten (YPM ENT 745093).

Paratypes. Florida, USA: 1 male, dissection no. 2015HLK:2101, DNA no. 10275-040502-FL, Gulf Co., vicinity of St. Joe Buffer off Hwy 30A, sandy habitat with *Amorpha herbacea* and oak, 29.6899°N, 85.3078°W, 1 m, at night light, 4 May 2002, J. Slotten (JS); 1 male, dissection no. 2015HLK:2102, DNA no. 10273-100502-FL, Gulf Co., vicinity of St. Joe Buffer off Hwy 30A, sandy habitat with *Amorpha herbacea* and oak, 29.6861°N, 85.3016°W, 2 m, UV Trap, 10 May 2002, J. Slotten (RJB).

Diagnosis.

Wing pattern ($n = 3$). *Catocala slotteni* (Figure 1A–C) is most similar in pattern to *C. whitneyi* (Figure 1D–J) and *C. abbreviatella* (Figure 1K–M), and appears somewhat intermediate between them. The margin of the reniform spot has a black outline except along the anterior edge, forming an inverted black J similar to *C. abbreviatella,* but lacking the basally projecting black triangle present in nearly all specimens of *C. whitneyi*. *Catocala slotteni* further differs from *C. whitneyi* by the smooth, shiny gray appearance of the dorsal forewing basal to the subterminal line; this area is distinctly coarser due to a mottling of dark gray scales in *C. whitneyi,* although it is comparably smooth in *C. abbreviatella*. In *C. abbreviatella* the black line bordering the distal side of the antemedial line is relatively thin and of similar width, whereas in *C. slotteni* and *C. whitneyi* the black line widens posteriorly forming a distally projecting triangle, although the triangle is narrower in *C. slotteni* than in most specimens of *C. whitneyi*.

Male genitalia ($n = 3$). *Catocala slotteni* can be distinguished from all species in the *C. nuptialis* species group by the shape of vesica diverticulum 1a. In *C. slotteni* diverticulum 1a has distinct proximal and distal sections separated by an abrupt change in shape (Figure 4K, yellow arrows show the division between the proximal and distal sections). The proximal section is wider and gradually tapering, whereas the distal section is narrow and fingerlike, of similar width throughout until the rounded apex (Figure 4A–C and K). In *C. whitneyi* diverticulum 1a is progressively tapering throughout and triangular in shape except for the rounded apex (Figure 4D–F). *Catocala abbreviatella* has the distinct proximal and distal sections like *C. slotteni,* but the distal portion is shorter and wider (Figure 4G). In *C. amestris* and *C. nuptialis* diverticulum 1a is short and triangular with a more pointed apex and no distinct proximal and distal sections (Figure 4H and I). Also, in *C. amestris* and *C. nuptialis* diverticulum 1b is less protruded than in the other species (Figure 4H and I), and least protruded in *C. amestris* (Figure 4H). Note that when diverticulum 2 is fully everted (Figure 4A–E and G) it often goes over the top of diverticulum 1a (Figure 4A, B, D, E and G), but sometimes diverticulum 2 bends over the apex of 1a almost 90°, as shown (Figure 4C).

COI 5′. Two consistent differences were found between *Catocala whitneyi* ($n = 4$) and *C. slotteni* ($n = 2$). *Catocala slotteni* has 61(G), whereas *C. whitneyi* and all other species in the *C. nuptialis* species group have 61(A). *Catocala whitneyi* and *C. amestris* have 376(A), whereas *C. slotteni* and other species in the *C. nuptialis* species group have 376(T). A clade of *C. whitneyi* + *C. slotteni* can be distinguished from all other sequenced *Catocala* species by the following combination of character states: 74(C), 127(T), 220(C), 274(T), 283(C), 386(C), 500(C), 532(C), 538(C), 562(C) and 619(C). All of these characters are binary within the *C. nuptialis* species group, and within this group the following character states are unique to the *C. whitneyi* + *C. slotteni* clade: 74(C), 127(T), 283(C), 500(C), 538(C), 562(C) and 619(C).

Description. The description is augmented with a more extensive series of figures available online (Lepidoptera Biodiversity, LLC 2016).

Head (Figure 1A–C). Vertex with mix of gray and light tan scales. Frons with predominately gray scales and mottled with lighter tan. Labial palp segments 1 and 2 white ventrally on inner side, gray on outer side, dark grayish black on lateral dorsal side,

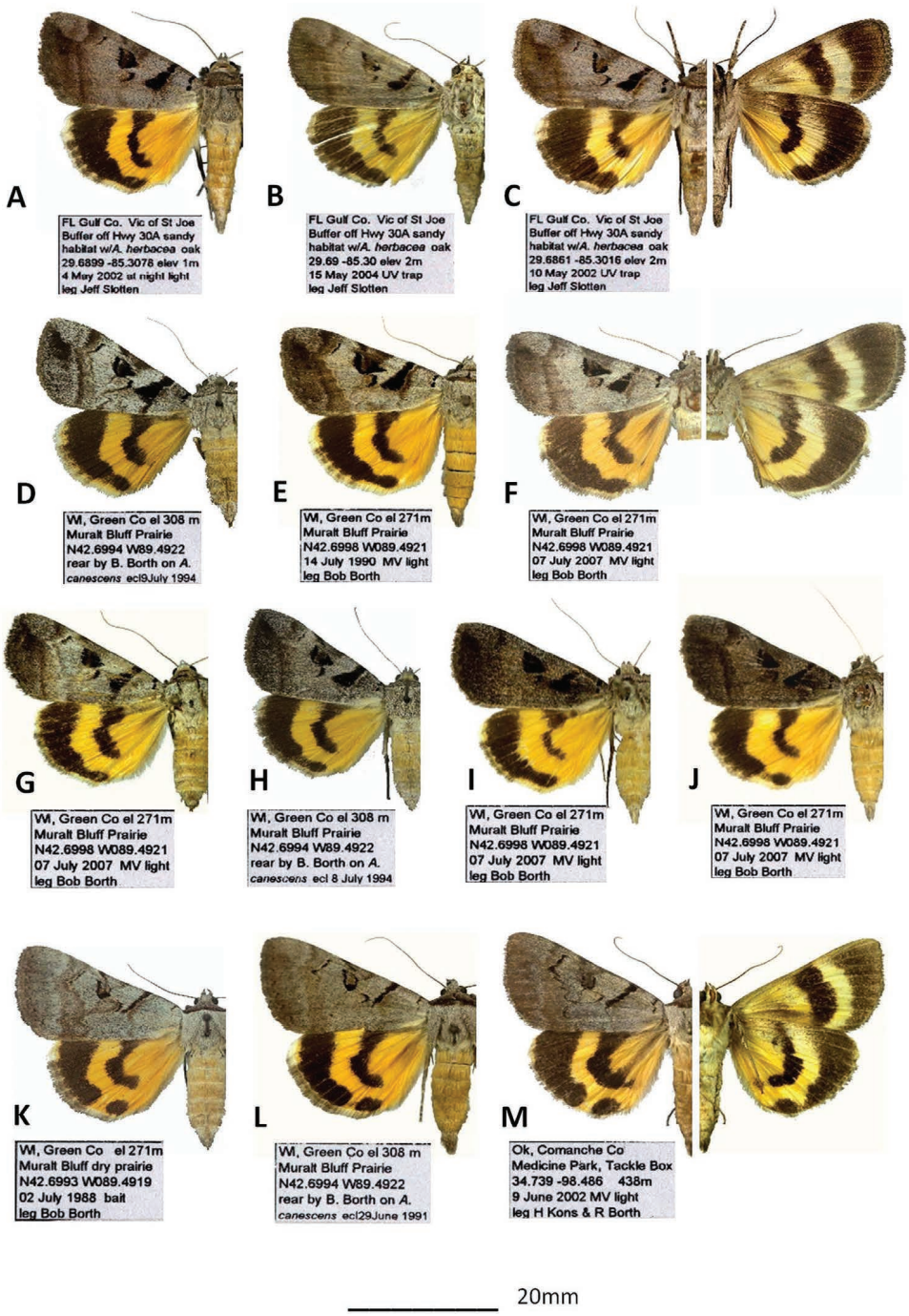

FIGURE 1. Adults of *Catocala slotteni, C. whitneyi* and *C. abbreviatella*. **A,** *Catocala slotteni* male (dissection no. 2015HLK:2101, DNA no. 10275-040502-FL). **B,** *C. slotteni* holotype male (YPM ENT 745093, dissection no. 2014HLK:2076). **C,** *C. slotteni* male (dissection no. 2015HLK:2102, DNA no. 10273-100502-FL). **D,** *C. whitneyi* female. **E,** *C. whitneyi* male. **F,** *C. whitneyi* female (dissection no. 2010HLK:689, DNA no. 2088-070707-WI). **G,** *C. whitneyi* female (DNA no. 2089-070707-WI). **H,** *C. whitneyi* female. **I,** *C. whitneyi* male (DNA no. 2087-070707-WI). **J,** *C. whitneyi* male (DNA no. 2086-070707-WI). **K,** *C. abbreviatella* female. **L,** *C. abbreviatella* male. **M,** *C. abbreviatella* male (DNA no. 565-8841-090602-OK).

FIGURE 2. *Catocala slotteni* male genitalic and leg structures. *C. slotteni* holotype: A–M, O–AA; dissection no. 2015HLK:2101: N. **A,** Capsule (ventral). **B,** Capsule (ventral, before hairs and scales removed). **C,** Capsule (dorsal). **D,** Capsule (lateral). **E,** Capsule (lateral, before hairs and scales removed). **F,** Valvae (inner). **G,** Uncus and tegumen (lateral). **H,** Uncus apical spine (ventral). **I,** Uncus (posterior). **J,** Uncus (lateral). **K,** Anellus/juxta (ventral flattened). **L,** Aedeagus (coecum hole oriented up). **M,** Aedeagus (coecum hole oriented down). **N,** Ventral aedeagus hood over everted vesica. **O,** Ductus ejaculatorius. **P,** Rectum and intestine. **Q,** Tergites 1 to 7. **R,** Sternites 2 to 7. **S,** Abdominal segment 8 (tergite on left). **T,** Protibia and profemoral apical spine (inner). **U,** Mesotibia (outer). **V,** Mesotibia (inner). **W,** Metatibia (outer). **X,** Mesotarsomeres 4 and 5 (lateroventral). **Y,** Protarsi (outer lateral). **Z,** Mesotarsi (outer lateral). **AA,** Metatarsi (outer lateral). *Abbreviations*: BCG, basal concave gouge; LIC, left inner chord; LOC, left outer chord; MN, medial notch; ROC, right outer chord; RSP, right sclerotized plate.

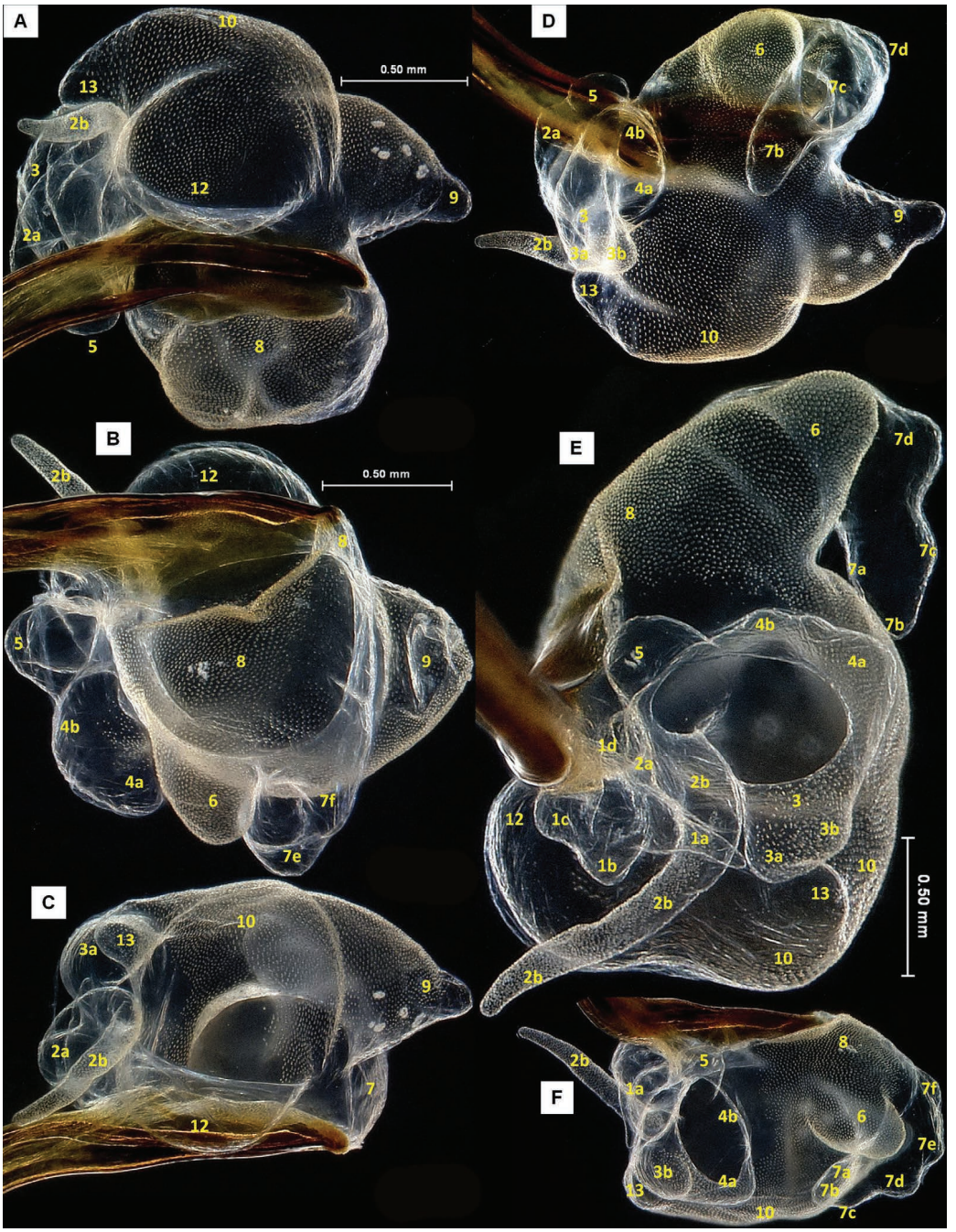

FIGURE 3. *Catocala slotteni* everted vesica (dissection no. 2015HLK:2101). The vesica diverticula numbering system follows Lepidoptera Biodiversity, LLC (2014). **A,** Ventral. **B,** Lateral (ventral hood above). **C,** Lateral (ventral hood below). **D,** Dorsal. **E,** Anterior. **F,** Lateral with apex tilted down (ventral hood above).

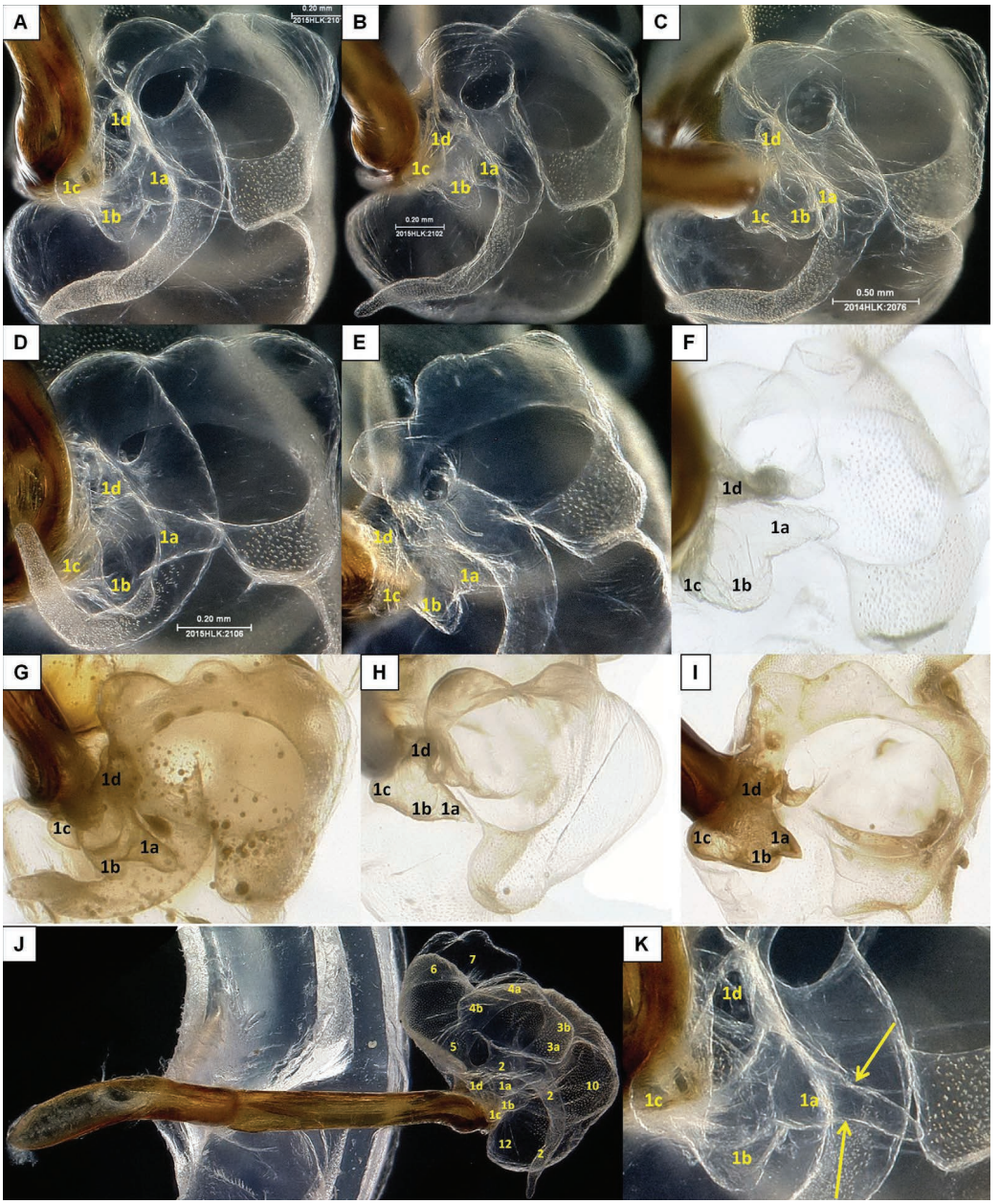

FIGURE 4. Comparison of diverticulum 1 among *Catocala slotteni* and related species (vesica in anterior aspect, zoomed in on diverticulum 1 and the anterior rosette of diverticula): A–I. Note that diverticulum 2 is largely uneverted in F, H and I. The vesica diverticula numbering system follows Lepidoptera Biodiversity, LLC (2014). **A,** *C. slotteni* (dissection no. 2015HLK:2101). **B,** *C. slotteni* (dissection no. 2015HLK:2102). **C,** *C. slotteni* holotype (dissection no. 2014HLK:2076); note the apex of diverticulum 1a is bent over. **D,** *C. whitneyi* (dissection no. 2015HLK:2106). **E,** *C. whitneyi* (dissection no. 2015HLK:2111). **F,** *C. whitneyi* (dissection no.2011HLK:689). **G,** *C. abbreviatella* (2011HLK:755). **H,** *C. amestris* (2011HLK:818). **I,** *C. nuptialis* (dissection no. 2011HLK:754). **J,** *C. slotteni* (dissection no. 2015HLK:2102), aedeagus quasi-perpendicular with vesica positioned in anterior aspect. **K,** *C. slotteni* (dissection no. 2015HLK:2101), enlargement of diverticulum 1 (anterior aspect).

gray mottled with light tan on ventral lower sides. Segment 3 with mixed gray and tan scales. Narrow band of whitish scales along dorsal and anterior margin of eye.

Thorax (Figure 1A–C). Patagia and tegulae predominately gray, many scales with pale white at apex, band of darker grayish brown along anterior margin. Ventral thorax densely covered with light gray hairs.

Wings

WINGSPAN: Forewing length (base to apex) of holotype and paratypes 22 mm.

FOREWING UPPER SIDE (Figure 1A–C): Background color predominately light gray with a smooth, shiny grayish appearance basal to the subterminal line, also including brownish and darker gray scales. Fresh specimens with a faint violet sheen. Dense brown scaling inside reniform spot, bordered by variable amount of black scaling forming a continuous (Figure 1A) or broken (Figure 1B) inverted J, black margin absent on anterior side and sometimes broken on posterior side. Basal dash absent. Basal line distinct, thin and black, with two disjunct patches, one within the discal cell, and one anterior to the radial vein. Antemedial line variably diffuse to sharp, thin, single, mostly brown but also with dark gray. Antemedial line with only two distinct loops, posterior loop smoothly curved between vein 2A and inner margin, anterior loop broad and shallow between vein 2A and costal margin, edge irregular but without distinct subloops. Distal side of antemedial line bordered by a contrasting black band extending from just posterior of vein Cu2 to the costal margin, proximal side slightly concave, distal side with four convex to triangular distally protruding lobes, widening (extending farther distally) anterior to posterior. Median line varies from broad and diffuse to nearly indiscernible (clearest in Figure 1A), margins and shape indistinct, curved loop between inner margin and vein CuA2, brown patch between vein CuA2 and vein M2, wider brown and darker grayish patch between reniform and anterior margin. Postmedial line largely indiscernible, but a partial or complete thin black to gray line present between vein M1 and the anterior margin in all three specimens (complete in Figure 1C). The remainder of the postmedial line is diffuse and obscure but still discernible (barely) under magnification in the specimen shown (Figure 1A), and comprised of double broken lines of darker gray scales (relative to the predominate background gray scales). Postmedial line undulations protrude distally as shallow curved loops or teeth: below 2A smoothly curved and extending slightly basally at vein 2A; between Cu2 and A2 a single curved loop, farther distal at vein Cu2 than vein 2A; between veins Cu1 and Cu2, a curved loop plus a basal extension to form a barely open subreniform spot, anterior side of subreniform with a contrasting solid black comma or spot in each specimen examined; two shallow curved loops between veins M3 and CuA1; a shallow curved loop between veins M2 and M3; a shallow distally protruding pointed tooth between veins M1 and M2, extending the farthest distally of any point on the postmedial line, irregular or weakly undulated line between veins R4 and M1; sharply turned basally along vein R4; between vein R4 and costa thin and fairly straight and merging with a thin broad patch along the costa. Subterminal line contrasting brown with diffuse margins, fairly straight and slanting outward (posterior to anterior) until nearly even with distalmost tooth of the postmedial line, then widening and curving anteriorly with a concave outer margin and convex inner margin. Area between postmedial and subterminal line a mix of light gray, darker gray and brown scaling, blending into the area dominated by light gray scales basal to the postmedial line. Area distal to subterminal line mixed with brown, dark gray and light gray scales, darkest part of wing except for a contrasting patch of predominately light gray curving from the subterminal line to vein M1 and then up to the apex; also with a contrasting patch of darker brown scales, primarily between veins M1 and M3 and bordering the contrasting lighter gray apical patch. Outer margin with diffuse, broken double lines of dark gray to brownish gray scales.

HIND WING UPPER SIDE (Figure 1A–C): Background color yellowish orange. Apical patch prominent, pale whitish tan with sparse scales of yellow-orange background color. Marginal band black, thickening posterior to anterior, unbroken in cell CuA2 (occasionally broken in closely related *Catocala whitneyi*) but with a concave or triangular indentation, remainder of anterior side concave, fairly smooth but with small indentations of hind wing background color. Medial band sharp, black, of variable thickness, abruptly changing direction on distal side along vein M2, curved distally anterior of vein CuA2, inner side jaggedly concave, outer side jaggedly convex except along vein M2, section in cell CuA2 highly variable in shape and curvature unclear, absent from the anal cell. Basal area predominately yellow orange but with diffuse band of black scales extending a variable degree distally. Fringe pale yellow orange with black patches at the ends of veins 2A and CuA2 to M1, diffuse black scaling at end of vein Rs, patches at ends of veins CuA2 to M1 broad and sometimes merged together (Figure 1C).

FOREWING UNDERSIDE (Figure 1C): Background color pale orange basal to medial band, pale cream color distal to medial band. Marginal and medial bands sharp and black; basal band diffuse. Marginal band with diffuse pale cream scaling along outer margin, with the pale scaling widening posterior to anterior. Inner marginal band absent. Dark gray scaling along costa, extending into medial and marginal bands on basal side. Fringe predominately black and dark gray with scattering of pale cream scales.

HIND WING UNDERSIDE (Figure 1C): Background pale orange basal to the medial band, distal to median band posterior to the vein Cu2, and along the distal side of the median band posterior to vein M2. Predominately pale cream between marginal and medial bands between veins M1 and Cu2. Anterior of vein M1 background heavily infused with black scaling, mixed with pale cream scales. Discal spot fused with basal margin of median band, nearly indiscernible but a slightly darker black than adjacent median band, crescent shaped and curving basally. Marginal and median bands sharp and black, of similar shape to upper side. Thin band of cream scaling along distal edge of marginal band. Fringe predominately mixed black and gray with sparser cream scales posterior of vein M1, predominately cream colored with sparse gray scaling anterior of vein M1.

Legs (Figure 2T–AA). All tarsi with similar spination: tarsomeres 1 to 4 with three ventral rows of large triangular spines, and two rows of minute hairlike curved spines between them. Tarsomere

5 with four ventral rows of large triangular spines, with a row of minute hairlike spines in-between each inner and outer row (Figure 2X). Scattered minute hairlike spines present along dorsal midline of tarsomeres and along sides. Tarsal claws simple.

FORELEG (Figure 2T and Y): Profemur unspined except for one flattened subapical spine on dorsal side. Protibia (Figure 2T) unspined, with a small convex sulcus with radiating spines near basal extremity on the inner side, setae on fringe of protibial flange very short and inconspicuous.

MIDLEG (Figure 2U, V and Z): Mesofemur unspined. Mesotibia with one row of 10 to 12 spines on outer side (Figure 2U); inner side unspined, with hair pencil groove (Figure 2V).

HIND LEG (Figure 2W and AA): Metafemur unspined. Metatibia with two to four closely clustered subapical spines on the outer ventral side; inner side unspined.

Abdomen. Tergites covered with gray scales and variable amount of orange-yellow hairs (Figure 1A–C), sternites covered with light gray scales speckled with darker grayish brown scales (Figure 1C). Abdominal cuticle tergites 1 to 7 as shown (Figure 2Q), sternites 2 to 7 as shown (Figure 2R), terminal tergite (left) and sternite (right) as shown (Figure 2S).

Male genitalia ($n = 8$). CAPSULE (Figure 2A–E): Juxta and vinculum strongly fused with valvae in the positions shown (Figure 2A, C and D), vinculum weakly fused with tegumen, vinculum arms laterally expanded and weakly fused midventrally (Figure 2A), diaphragma membranous except for juxta/anellus (Figure 2A).

VALVAE (Figure 2F): Outer surfaces densely covered with elongate light tan colored hairlike scales except for anterior portion of sacculus, some darker grayish tan hairlike scales emanating from the medial portion of the cucullus (Figure 2B and E); inner surface of "cucullus" with shorter hairlike scales and hairs along ventral margin. Sacculus without posterior extension at fusion with cucullus, instead curved anteriorly (Figure 2F). Ventral inner sides of sacculus with concave indentation along margin of clasper base (Figure 2A). Posterior to anterior edge of indentation, dense elongate setae projecting inward/ventrally along posterior margin of sacculus on inner side. Right and left cucullus clear and membranous except for a thin band of sclerotization bordering the posterior roughly half of the costa, and in two of the three specimens a faint thin band of sclerotization along the ventral edge of the cucullus from the saccular margin to just anterior of the position of the clasper apex. Cucullus with scattered elongate setae on inner surface along ventral margin. Left and right costa heavily sclerotized and of similar width throughout, slightly wider medially, neither extending distally beyond cucullus; thickened area of both costae extending nearly to posterior edge of cucullus but without a distinct posterior margin, terminus of "costa" not clearly separated from sclerotized cucullus (Figure 2F). Claspers nearly symmetrical, dorsoventrally flattened basally, laterally flattened distally, curved ventrally/inward distally. Clasper apices and posterior side of inner surface covered with scattered minute short setae, apices slightly expanded relative to subapical area. Ventral margin of clasper base with scattered short setae, trending toward slightly shorter distally. Ventral base of clasper with small patch of elongate setae, only a few scattered long setae at the dorsal base. Viewed from ventral side, claspers with outer margin (bordering the cucullus) convex and inner margin (opposite the cucullus) convex medially and concave proximally and distally.

JUXTA (Figure 2K): Two elongate symmetrical lobes, narrowest posteriorly, progressively widening anteriorly. Lobes fused to anellus at posterior apex, touching each other at posterior end but not fused together.

ANELLUS (Figure 2K): Lobes fused together throughout and appearing as a single sclerotized plate, somewhat asymmetrical, two concave posterior indentations on the outer margin of each lobe, small posterior indentations and broad anterior indentations. The anterior indentation extends farther posteriorly on the left lobe, whereas the posterior indentation is deeper on the right lobe. These indentations give the outer sides an undulating appearance, and anterior to posterior they are convex to concave to convex to concave. Posterior apex a convex protrusion, anterior edges of both lobes convex. Wide band of sclerotized, dense, shallow depressions (pits) along midline; sclerotization of this pitted area darker than remainder of plates, varying from blackish to a darker tannish brown. The pitted area extends variably outside the midline region along the posterior and anterior edges of each lobe.

UNCUS (Figure 2I and J): Tubular, of similar width throughout, slightly wider near proximal edge of sclerotized area on anterior side. Posterior margin convex proximally and distally and fairly straight in-between, anterior margin concave proximally and distally and fairly straight in-between. Terminating in a heavily sclerotized curved spine, appearing pointed apically in lateral view (Figure 2J), but actually narrowly rounded, as visible in dorsoventral view (Figure 2H); posterior edge of uncus (excluding spine) fairly flat, shaped as shown (Figure 2H). Conspicuous setae throughout the length of the uncus projecting from the sides, some more than three times the posterior width of the uncus, widest setae medially, most setae angle dorsally but some close to base are roughly perpendicular to the uncus or project slightly ventrally, setae distinctly shorter subapically (less than width of the uncus), fewer scattered setae on the posterior side.

TUBA ANILIS (Figure 2G): Membranous except for scaphium. Scaphium an elongate, concave, rectangular plate, terminating near but distinctly dorsal of uncus apex (Figure 2I and J) (note in Figure 2J the distal portion of the scaphium is underneath a fold in the tuba anilis but still visible).

AEDEAGUS (Figure 2L and M): Translucent throughout. Coecum bent about 10° to 25° just anterior of anterior opening. Aedeagus slightly bent at posterior margin of coecum (about 10° to 25°), then bent about 30° to 45° roughly five-eighths of the distance from the posterior margin of the coecum to the posterior apex, fairly straight in-between with the ventral side very slightly convex and the dorsal side slightly concave (Figure 2L). Vesica projects from posterior opening about 90° to the right of coecum opening.

AEDEAGUS VENTRAL HOOD (Figure 2N): Left flank of posterior ventral extension ("hood" over everted vesica) with a broad basal

concave gouge but convex apically, right flank (outer edge of right outer chord) concave basally and fairly straight to slightly convex distally, with concave right sclerotized plate fused to right outer chord; apex of hood doubly convex with a medial notch. Right outer chord thick and heavily sclerotized for roughly the proximal fourth of the hood, then becoming thin and diffuse and barely discernible by the apex of the right flank. Right inner chord absent. Left inner chord thick and prominently sclerotized throughout length of the hood, fused with left outer chord at apex of hood. Left outer chord thick and prominently sclerotized only for roughly apical fourth of the hood, indistinct along remainder of left flank.

DUCTUS EJACULATORIUS (Figure 2O): Slender region bent over about 180° just before scoop-shaped region. Scoop-shaped region outer side concave basally, strongly convex distally; inner side convex basally, strongly concave distally. Apex of scoop curves back around near or at the point of the sharp bend at the terminus of the slender region.

VESICA (Figure 3A–F): Diverticulum 1 distinctly tetralobal, 1a with distinct proximal and distal sections separated by an abrupt change in shape (Figure 4K), proximal section wider and gradually tapering, distal section narrow and fingerlike and of similar width throughout until the rounded apex (Figures 3E and 4A–C and K); 1b to 1d simple convex lobes (Figure 4A–C and K). Diverticulum 2 bilobal, 2a broad and convex, much wider than high; 2b narrow and very elongate, gradually tapering to a rounded apex, covered with minute inverted unsclerotized teeth for most of its length except near base (Figure 3E). Diverticulum 3 convex on sides and fairly straight in-between, not distinctly bilobed (Figure 3E). Diverticulum 4 weakly bilobed, with two broad convex bulges each much wider than high (Figure 3E). Diverticulum 5 a simple prominently protruding convex lobe (Figure 3E). Diverticulum 6 large, simple lobe, densely covered with small inverted teeth, much shorter than diverticulum 7 (Figure 3B and D–F). Diverticulum 7 elongate, strongly curved over dorsally underneath the vesica (Figure 3D–F), with six shallow convex lobes, four along the outer side (7f to 7c), one subapically on the inner side (7a), and the apex (7b) (Figure 3F). Diverticulum 8 large, broad and smoothly curved, covered with minute inverted teeth (Figure 3A and B), extending along the right flank of the aedeagus hood and around in front of the apex (Figure 3A). Diverticulum 9 large, projecting posteriorly (Figure 3A, C and D) and curving inward at apex (Figure 3B), with distinct basal and distal sections, basal section large with convex sides strongly and progressively tapering, distal section a small, short convex bulge only slightly tapering before rounded apex (Figure 3A, C and D). Diverticulum 10 large and broad, low and smoothly curved (Figure 3D). Diverticulum 11 absent or not discernible. Diverticulum 12 a prominent, smoothly curved, simple convex bulge slightly extending over aedeagus hood on left flank (Figure 3A). Diverticulum 13 a prominent simple convex bulge (Figure 3D and E).

Female genitalia. Unknown.

COI 5′ mitochondrial DNA. One haplotype has been recorded with a sample size of two specimens. This haplotype has the following sequence for COI 5′ positions 1 to 658:

AACTTTATATTTTATTTTTGGAATTTGAGCAGGAATAG
TAGGAACTTCATTAAGATTATTGATTCGAGCTGAACT
AGGTAATCCCGGATCCTTAATTGGAGATGATCAAATT
TATAATACTATTGTTACAGCTCATGCCTTTATTATAATT
TTTTTCATAGTTATACCAATTATAATTGGAGGATTTGG
TAATTGATTAGTACCTTTAATATTAGGAGCCCCTGATA
TAGCTTTCCCCCGTATAAATAATATAAGTTTTTGACTT
CTACCCCCTTCATTAACCTTACTAATCTCAAGAAGAAT
TGTAGAAAATGGAGCAGGAACTGGATGAACAGTTTAC
CCCCCTCTTTCTTCTAATATTGCCCATAGAGGTAGTTC
AGTAGATCTAGCTATTTTTTCATTACACTTAGCTGGAA
TTTCTTCAATCTTAGGAGCTATTAATTTTATTACCACA
ATTATTAATATACGATTAAATAATTTAATATTTGATCAA
ATACCTCTATTTGTTTGAGCTGTAGGAATTACAGCATT
CCTTCTCCTTCTCTCTTTACCAGTATTAGCCGGTGCTA
TCACTATACTTTTAACTGACCGAAACTTAAATACTTCT
TTCTTTGACCCCCGCTGGAGGAGGAGATCCTATTTTAT
ATCAACATTTATTT

Etymology. The new species is named for Jeff Slotten, who collected all three of the specimens known.

Discussion

Catocala slotteni remains poorly documented, with only three specimens collected in close proximity and nothing recorded about its life history. Larvae of all other species in the *C. nuptialis* species group have been found on *Amorpha* in the wild. In Wisconsin, larvae of *C. abbreviatella* and *C. whitneyi* have been found on *Amorpha canescens* on prairies (Borth and Barina 1991). The distribution of these two species occurs within a subset of the distribution of *A. canescens* (USDA NRCS 2016), suggesting that *A. canescens* may be the primary host for these. Larvae of *C. nuptialis* have been found in Wisconsin on *Amorpha fruticosa* L. (L.F. Gall, pers. comm., 2016), and sites where we have found *C. nuptialis* in Wisconsin and Indiana are in or near *A. fruticosa* habitats. Larvae of *C. amestris* have been found on *A. canescens* on Wisconsin prairies (Borth and Barina 1991), but *C. amestris* is more widespread in North America and uses other *Amorpha* species. Wild larval records for the *C. nuptialis* group for states other than Wisconsin include (L.F. Gall, pers. comm., 2016): *C. abbreviatella* on *A. canescens* (Illinois); *C. amestris* on *A. canescens* (Illinois, Indiana, Michigan, Texas) and *A. fruticosa* (Florida, Michigan, Texas); *C. nuptialis* on *A. fruticosa* (Arkansas, Iowa); and *C. whitneyi* on *A. canescens* (Illinois).

Given that all four closely related species are *Amorpha* specialists, *Amorpha* habitats would be a

logical starting point for investigating the life history of *Catocala slotteni* and to discover new populations, although the possibility of other leguminous host plants cannot be dismissed. Two species of *Amorpha* are recorded from Gulf County and the Florida Panhandle: *A. herbacea* Walter and *A. fruticosa* (USDA NRCS 2016). *Amorpha fruticosa* has a widespread North American distribution, whereas *A. herbacea* is limited to the southeastern United States from North Carolina south through peninsular Florida and west to southern Alabama (USDA NRCS 2016). While *Amorpha* was not present at the exact locations where *C. slotteni* has been collected, *A. herbacea* occurs less than 1.5 km away in the Saint Joseph Bay Buffer Preserve, where we only observed it growing along the edges of mowed trails. In Florida, *A. fruticosa* occurs in hydric habitats, usually along hardwood forest margins near rivers and streams, whereas *A. herbacea* occurs in various xeric sandy habitats. If either of these are the host of *C. slotteni*, the host appears to be more widespread than *C. slotteni.* For example, an *Amorpha herbacea* habitat in the Withlacoochee State Forest in Citrus County, Florida, has been surveyed during the *C. slotteni* flight season by ourselves and other lepidopterists, and while *C. amestris* has been repeatedly recorded from this site, *C. slotteni* has never been found. *Amorpha fruticosa* is plentiful at Clyde Hopkins Municipal Park in Gadsden County, Florida, where we have intensively surveyed for *Catocala* during May without finding *C. slotteni* (Kons and Borth 2006). However, all other northern Florida survey localities covered in Kons and Borth (2006) contained few or no *Amorpha* plants of either species. Wisconsin *A. canescens* prairie habitats may contain zero, one, two or all three of the *A. canescens*–feeding species, with *C. whitneyi* appearing to be the most localized. Therefore, the inability to find *C. slotteni* in some Florida *Amorpha* habitats might be expected even if these habitats contain the host plant.

All three of the *Catocala slotteni* specimens were collected at lights: two in ultraviolet (UV) light traps and one at a building light. In our experience, *C. whitneyi* and *C. abbreviatella* are most readily found at mercury vapor (MV) or UV lights, although they can also be found at bait. *Catocala amestris* and *C. nuptialis* may be more plentiful at either lights or bait, depending on how well bait is attracting moths overall. Borth and Barina (1991) reported peak flight times at MV or UV sheets on Wisconsin prairies from 2300 to 0200 hr for *C. abbreviatella* and from 0130 to 0300 hr for *C. whitneyi.* Kons and Borth (2006) noted that on warm nights in northern Florida peak activity of moths at sheets often occurs late at night, often after 0300 hr. Monitoring lights and bait throughout the night in early May could maximize the chances of successfully finding *C. slotteni* adults, although all recent efforts to locate the species have been unsuccessful. Searching for *C. slotteni* larvae in late March and early April is also recommended based on life-history studies of *C. whitneyi*: Borth and Barina (1991) found the larvae of *C. whitneyi*, *C. abbreviatella* and *C. amestris* on *Amorpha* plants only at night, and L.F. Gall (pers. comm., 2016) has similarly found larvae of *C. nuptialis* and *C. amestris* on the host plants at night.

All three *Catocala slotteni* specimens were collected in a coastal dune and swale ecosystem on land that is now included within the St. Joseph Bay Buffer Preserve, which protects an intact coastal landscape with more than 20 species of protected plants (Florida DEP 2012). This landscape is believed to have been subjected to frequent natural fires for thousands of years (Florida DEP 2012). Historically, Florida wildfires were often originated by lightning strikes (Myers and Ewel 1990). In northern Florida lightning strikes typically begin with the start of the rainy–thunderstorm season in late May or June following a hot and dry period in late April and the beginning of May. We have noted relatively few Lepidoptera larvae apparent in the herbaceous layer of northern Florida habitats at the start of the rainy season. However, when new growth is prevalent in March and April, Kons has observed larger numbers of Lepidoptera larvae in Florida habitats than at any other time of year, including xeric habitats. The manager at St. Joseph Bay Buffer preserve indicated that prescribed burning takes place on buffer preserve lands in mosaic style between the end of January and early June in 2 to 3 year cycles (D. Shoemaker, pers. comm., 2016). There is some evidence that spring burning of prairie *Amorpha* habitats causes mortality in the immature stages of *C. whitneyi* and *C. abbreviatella*: 19 larvae of *C. abbreviatella* and *C. whitneyi* on *Amorpha canescens* were found in an unburned section of a Wisconsin prairie the night of 31 May 2015, but no larvae were present in a recently burned por-

tion of the same prairie despite the occurrence of profuse new growth in this area (see Borth and Barina 1991). Therefore, management practices expected to contribute to the conservation of *C. slotteni* include ensuring that burn units include only a fraction of a particular habitat type present in an area, and when possible, conducting burns near the start of the rainy season after the period when larvae of *C. slotteni* are expected to be active.

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