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**A review of the Nearctic species of *Nematodes* (Coleoptera: Eucnemidae: Macraulacinae: Nematodini) with a description of one new species**

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A journal of world insect systematics

# INSECTA MUNDI

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**0881**

A review of the Nearctic species of *Nematodes*  
(Coleoptera: Eucnemidae: Macraulacinae: Nematodini)  
with a description of one new species

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# A review of the Nearctic species of *Nematodes* (Coleoptera: Eucnemidae: Macraulacinae: Nematodini) with a description of one new species

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**Abstract.** The Nearctic species of *Nematodes* Berthold (Coleoptera: Eucnemidae: Macraulacinae: Nematodini) are reviewed. Four species are redescribed. One **new species**, *Nematodes rugosipennis* Otto (Coleoptera: Eucnemidae) is described from Florida, Georgia, and Oklahoma, USA. A key to species modified from Muna (2000) is provided for all known species of *Nematodes* present in the Nearctic region.

**Key words.** False click beetles, taxonomy, systematics, femoral ridge, Florida.

**ZooBank registration.** urn:lsid:zoobank.org:pub:A6DE8E5B-98F9-4F31-BE36-E84EC1DB596F

## Introduction

While identifying false click beetles (Coleoptera: Eucnemidae) in the Florida State Collection of Arthropods, I discovered a new species of *Nematodes* Berthold collected in Florida. Additional specimens of the new species were identified from the Carnegie Museum of Natural History, California Department of Food and Agriculture, Kyle Schnepf's personal collection, and the collection of the Global Eucnemid Research Project. Between this discovery of a new species of *Nematodes* Berthold, a forthcoming global review of a tribe within the subfamily Eucneminae, and additional studies adding new records of exotic species present in the United States, the known eucnemid fauna continues to grow in the region. To date, the temperate Nearctic region north of Mexico has approached at least 100 species, placing the region in the same league along with other subtropical and tropical countries. In the years to come, more new eucnemid discoveries are bound to take place, adding to the already growing number of species known in the region.

*Nematodes* is a moderately large group consisting of 48 species, including a number of undescribed species in the Neotropical and Oceanic regions (Otto 2017). The group is primarily distributed in the Neotropical region, with a small number of species in other regions around the globe. Five described species, including the species described here, are distributed in eastern North America, north of Mexico. Twenty-three described species are found in the Neotropical region, including the Caribbean Islands. One species occurs in much of Europe and Russia. Two species are distributed along the eastern coastline of the Australian continent. One species is present on the African continent. Nine species are represented in Southeast Asia, including Japan.

## Materials and Methods

Specimens were examined under a goose neck table lamp, through a Wild M3Z 6.4–40x zoom stereo binocular microscope with 20x oculars. Habitus and other structural images were taken with a JVC KY-F75U digital camera attached to a Leica® Z16 APO dissecting microscope with apochromatic zoom objective and motor focus drive, using a Synchroscope Auto-Montage® Pro System and software version 5.01.0005, resulting image stacks were processed using CombineZP®. All images were captured as TIFF files during the imaging process. Each image was modified through a paint program and Photoshop Elements 10® software on a Toshiba Satellite® C55 series laptop computer and all were collated into plates through the computer's paint program. The size of each plate was modified to 300 dpi.

Adult measurements were taken using a ruler. Habitus length was measured from the apex of the head to the apex of the elytra. Habitus width was measured across the humeri, just below the base of the pronotum. Pronotal lengths were measured across the midsection from the apex to the base above the scutellar shield. Pronotal widths were measured across the base of the pronotum above the elytral humeri.

Aedeagi were dissected following immersion of sectioned abdomen in KOH for three hours at a concentration of one tablet in 40 ml of water. Aedeagi were suspended in Germ-X® hand-sanitizer for imaging. The abdomen was secured on cardstock and pinned beneath the corresponding specimen. The dissected aedeagus was stored in a microvial filled with glycerin and pinned beneath the abdomen and corresponding specimen.

The study was based on the examination of 510 dry mounted and pinned specimens borrowed from a small number of collections as noted below:

C DFA	California Department of Food and Agriculture, Sacramento, CA
CMNH	Carnegie Museum of Natural History, Pittsburgh, PA
FSCA	Florida State Collection of Arthropods, Gainesville, FL
GERP	Global Eucnemid Research Project, UW Dept. of Entomology, Madison, WI
KESC	Kyle E. Schnepf Collection, Gainesville, FL
WIRC	Wisconsin Insect Research Collection, UW Dept. of Entomology, Madison, WI

Label data are presented verbatim, with text for each individual label placed inside quotation marks and separated from an underlying label by a slash (/). Observed metadata for some labels are placed inside parenthesis and/or brackets. Each specimen deposited in the collection of the Global Eucnemid Research Project (GERP) bears a green framed white label, “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)”.

## Systematics

### Subfamily Macraulacinae Fleutiaux, 1922 Tribe Nematodini Leiler, 1976

#### Genus *Nematodes* Berthold, 1827

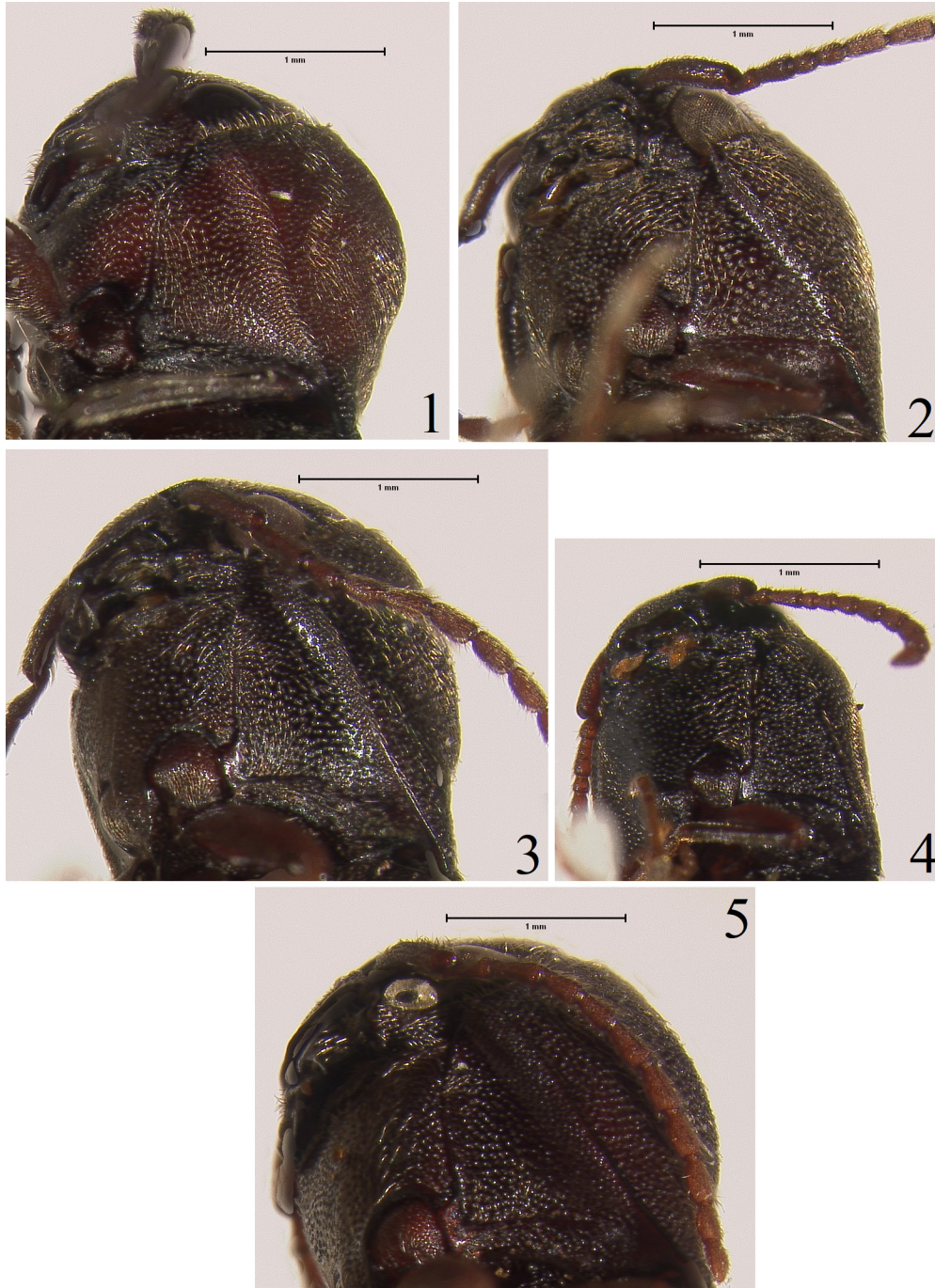
**Diagnosis.** Apical margin of frontoclypeal region feebly trilobed and more than twice as wide as the base; antennal grooves absent; male protarsomere I simple with basally curved sex combs; tarsal claws simple; tarsomere IV excavate-emarginate; metacoxal plates medially 3.0–6.0 times wider than laterally; last visible ventrite strongly produced; lateral surfaces of meso- and metatibiae with setae and transverse rows of spine combs; metathoracic episterna parallel-sided; male aedeagus dorsoventrally compressed, with laterally attached secondary lateral lobes; median lobe simple, with moderately and narrowly bifurcate apices; lateral lobes simple, entire; flagellum simple (Muona 1993, 2011; Otto 2016).

These diagnostic characteristics, especially the presence of excavate-emarginate tarsomere IV and parallel-sided metathoracic episterna will distinguish the group from any genera within the tribe Nematodini. The new identification key will largely feature the overall length of the femoral ridge at the base of the hypomera where the femur rests when legs are reposed as a means to diagnose each species present in this region.

#### Key to the species of *Nematodes* in the Nearctic region

1. Femoral ridge well-developed, elongate, at least  $\frac{1}{2}$  the length of the hypomeral base ..... 2
- Femoral ridge poorly-developed, short, about  $\frac{1}{3}$  the length of the hypomeral base (Fig. 1) .....  
..... *N. collaris* Bonvouloir
2. Femoral ridge incomplete, not reaching to the lateral side of the pronotum ..... 3
- Femoral ridge complete, reaching to the lateral side of the pronotum (Fig. 2) ... *N. humphreyi* Muona
3. Femoral ridge reaching about  $\frac{1}{2}$  the length of the hypomeral base (Fig. 3) ..... *N. atropos* (Say)
- Femoral ridge reaching close to the lateral side of the pronotum (Fig. 4, 5) ..... 4

4. Antennomere V sub-equal to antennomere VI ..... *N. penetrans* (LeConte)  
 — Antennomere V shorter than antennomere VI ..... *N. rugosipennis* Otto sp. nov.



**Figures 1–5.** *Nematodes* species. 1) *Nematodes collaris* Bonvouloir, base of hypomeron. 2) *Nematodes humphreyi* Muona, base of hypomeron. 3) *Nematodes atropos* (Say), base of hypomeron. 4) *Nematodes penetrans* (LeConte), base of hypomeron. 5) *Nematodes rugosipennis* Otto sp. nov., base of hypomeron (Scale: 1–5 = 1.0 mm.)

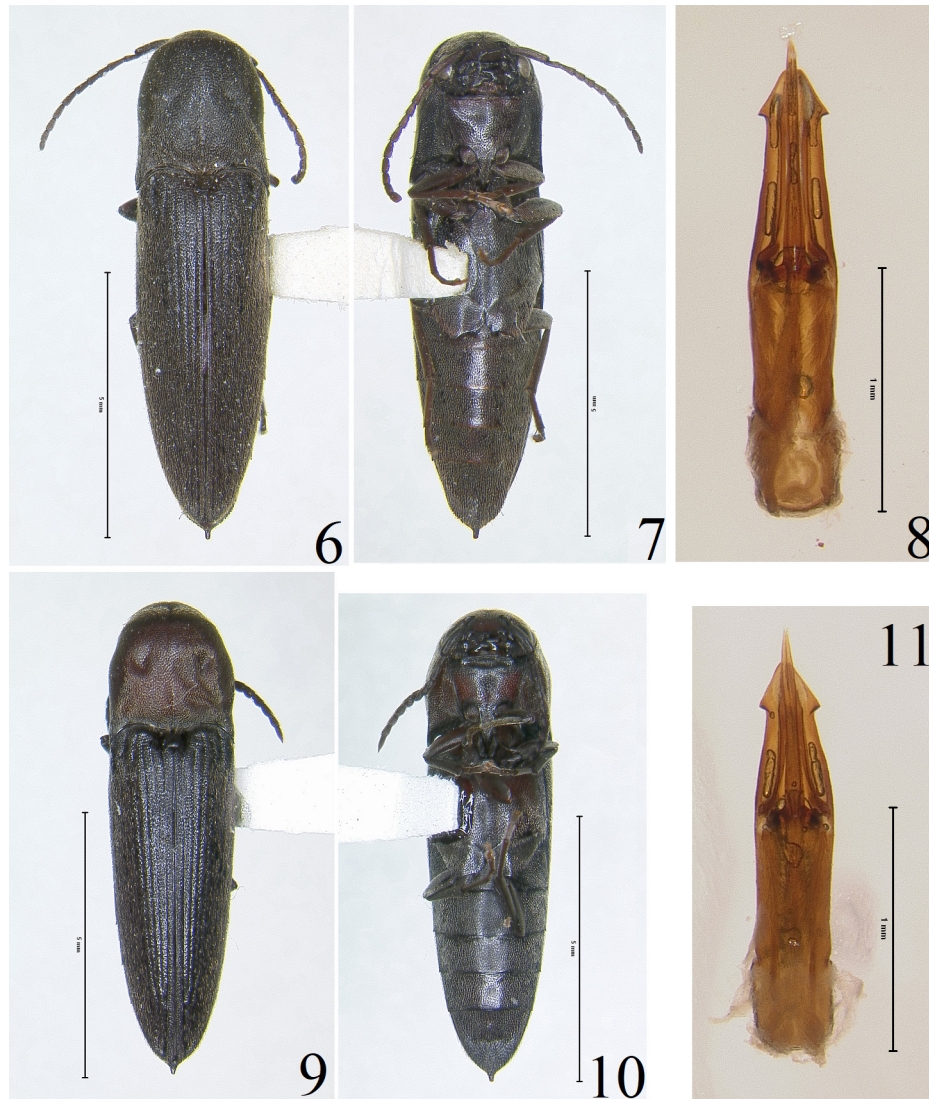
***Nematodes atropos* (Say)**

Fig. 6–8

*Eucnemis atropos* Say 1836: 187–188

**Diagnosis.** Elongate and strongly-developed incomplete femoral ridge extending about ½ the length of the hypomeral base will readily distinguish the species from other *Nematodes* species present in the Nearctic region.

**Specimens examined.** Sixty-three specimens were available for study: **FLORIDA:** “FLORIDA: Gainesville, 3517 NW 10TH Ave., 17-V-1993, R.E. Woodruff, blacklight trap” (1, FSCA); “FL: Alachua Co., Gainesville, NW 51st Terrace, 6 May 2009, coll. O.J. Blanchard” (‘st’ superscript on label) / “black, light” (1, FSCA); “FL: Alachua Co., Gainesville, NW 51st Terrace, 13 May 2009, coll. O.J. Blanchard” (‘st’ superscript on label) / “black, light” (1, FSCA); “Florida: Alachua Co., Paynes Prairie Preserve, State Park campground, May 3, 2012 at light, Kyle E. Schnepf” (1, KESC); “Florida: Alachua Co., San Felasco Preserve, April 5–May 6, 2014, Lindgren funnel trap, Kyle E. Schnepf” (1, KESC); “Florida: Alachua Co., San Felasco Hammock, Preserve State Park, April 15, 2014, Kyle E. Schnepf” / “beaten from fallen, chinkapin oak branch, *Quercus muehlenbergii*” (1, KESC); “Florida: Alachua Co., 3.4 miles WNW Archer, March 28, 2016 beaten, from dead oak branch, Kyle E. Schnepf” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (‘17’ handwritten on label) (1, KESC); “Florida: Suwanee Co., ~7 miles W White Springs, May 16–June 20, 2017, Lindgren funnel trap, Kyle E. Schnepf” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (1, KESC); “Florida: Liberty Co., Torreya S.P. at light, May 11, 2018, Kyle E. Schnepf” (1, KESC); “Florida: Alachua Co., San Felasco H.P.S.P., April 24–May 5 2021, Lindgren funnel trap, Kyle E. Schnepf” (2, KESC). **GEORGIA:** “GEORGIA: Chatham Co., 1.4 km WNW Port Wentworth, 32.15091, -81.17832, 13m, 22 Mar–6 Apr 2016, LFT, R. Morgan, BSF# 66614” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (1, CMNH); “GEORGIA: Chatham Co., 1.4 km WNW Port Wentworth, 32.15091, -81.17832, 13m, 5–19 Apr 2016, LFT, R. Morgan, BSF# 66615” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (1, CMNH); “GEORGIA: Chatham Co., 1.4 km WNW Port Wentworth, 32.15091, -81.17832, 13m, 5–19 Apr 2016, Lindgren FT, R. Morgan, BSF# 66618” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (2, CMNH); “GEORGIA: Chatham Co., 1.4 km WNW Port Wentworth, 32.15091, -81.17832, 13m, 16 Apr–2 May 2016, LFT, R. Morgan, BSF# 66583” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (1, CMNH); “GEORGIA: Chatham Co., 1.4 km WNW Port Wentworth, 32.15091, -81.17832, 13m, 19 Apr–3 May 2016, LFT, R. Morgan, BSF# 66613” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (3, CMNH); “GEORGIA: Chatham Co., 1.9 km N Garden City, 32.13098, -81.15114, 3m, 19 Apr–3 May 2018, LFT, S. Davis, BSF#78777” (1, CMNH); “GEORGIA: Chatham Co., 0.9km ENE Port Wentworth, 32.15005, -81.15388, 3m, 19 Apr–3 May 2018, LFT, S. Davis, BSF#78796” (2, CMNH); “GEORGIA: Chatham Co., 2.3 km NW Garden City, 32.1235, -81.17599, 5 m, 17–31 May 2018, LFT, S. Davis, BSF#79491” (1, CMNH); “GEORGIA: Chatham Co., 0.8km ENE Port Wentworth, 32.15031, -81.15459, 3m, 17–31 May 2018, LFT, S. Davis, BSF#79559” (1, CMNH). **ILLINOIS:** “ILLINOIS: White County, 1.2 km SSE Grayville, 38.248574, -87.98698, 125m, 4–8 Jun 2018, T. Vorce, LFT, BSF#82162” (1, CMNH). **INDIANA:** “Indiana: Morgan Co., June 12–July 10, 2009, purple sticky trap, Kyle E. Schnepf” (1, KESC); “Indiana: Morgan Co., July 10–20, 2009, purple sticky trap, Kyle E. Schnepf” (1, KESC); “Indiana: Morgan Co., June 14–29, 2010, black panel trap EtOH, Kyle E. Schnepf” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2014” (1, KESC); “Indiana: Morgan Co., June 29–July 11, 2010, black panel trap EtOH, Kyle E. Schnepf” (1, KESC). **KANSAS:** “USA: Kansas: Labelle Co., Big Horn Reservoir, NW of dam, 37° 16.55’N 95° 28.43’W, 2–13-VI-2005 G.A. Salsbury, ex. canopy trap KAN1S05 100” (1, GERP); “USA: Kansas: Johnson Co., Overland Park Arboretum, 38°48.094’N 94°41.310’W, 12–20-VI-2006, A. Cruz ex., canopy trap KAN1S06 067” (1, GERP); “KANSAS: Wyandotte Co., 3.5km WSW Kansas City, 39.10374, -94.66579, 268m, 17 May–7 June 2018, LFT, S. Roberts, BSF#83457” (2, CMNH); “KANSAS: Jefferson Co., 2.5km N Grantville, 293m, 39.105735, -95.557166, 10 Jun–1 Jul 2019, LFT, S. Pellato, BSF#91322” (1, CMNH); “KANSAS: Jefferson Co., 2.5 km N of Grantville, 39.105735, -95.557166, 293m, 1–8 Jul 2019, LFT, S. Pellato, BSF#91323” (1, CMNH). **LOUISIANA:** “LA: Baton Rouge, Place DuPlantier, Apts. V.26.85, Coll. E.G. Riley” (date handwritten) / “window trap” (3, GERP). **MISSOURI:** “MO: Jackson Co., Jackson, June 1998” (2, GERP); “MISSOURI: St. Louis Co., 2.4 km E Maryland Heights, 38.71261, -90.40263, 193m, 14–27 June 2016, LFT, L. Trevathan, BSF#70244” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2017” (1, CMNH). **OHIO:** “OHIO, Scioto Co., Shawnee St. For., IX-1980” (“IX-” and “80” were handwritten) / “collectors:, B&BValentine” / “Valentine, Coll’n, Rec. 2016” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2019” (10, FSCA); “USA: OH Cuyahoga Co., 09-VI-2000, on dead Hickory, cold



**Figures 6–11.** *Nematodes* species. **6** *Nematodes atropos* (Say), female, dorsal habitus. **7** *Nematodes atropos* (Say), female, ventral habitus. **8** *Nematodes atropos* (Say), male, aedeagus, dorsal. **9** *Nematodes collaris* Bonvouloir, female, dorsal habitus. **10** *Nematodes collaris* Bonvouloir, female, ventral habitus. **11** *Nematodes collaris* Bonvouloir, aedeagus, dorsal. (Scale: 8, 11 = 1.0 mm; 6–7, 9–10 = 5.0 mm.)

by RJBuss” / “*Nematodes, collaris* ?” (handwritten in pencil) (1, GERP); “OH: Preble Co., Camden, 29 June 2001, Michael Ulyschien, Blacklight” (1, GERP); “OHIO: Allen County, 3 km SW Lima, 263m, 40.7273, -84.1348, 19 Jun–3 Jul 2018, LFT, C. Poe, BSF#82558” (1, CMNH). **SOUTH CAROLINA:** “Dovehaven,” 7 mi., N.E. of Pickens, S.C., 11.VII.1979, H.L. Dozier” (“11.VII.” and “79” were handwritten) (1, FSCA); “South Carolina: Pickens Co., ~5 miles north Clemson, June 20, 2018, under bark of fallen tree, Kyle E. Schnepf” / “*Nematodes, atropos*, (Say), Det. R.L. Otto, 2019” (2, KESC). **TEXAS:** “TEXAS: Sabine Co., 9 mi., E. Hemphill “Beech, Bottom”, V-8-21-1989, R. Anderson & E. Morris, Malaise trap, beech-magnolia forest” (2, GERP). **VIRGINIA:** “VA: Appomattox Co., Appomattox, 29 – 30 June 2000, Robert Vigneault” (4, GERP).

**Redescription.** Length, 6.0–10.0 mm. Width, 1.5–2.0 mm. Body subcylindrical, elongate; uniformly dark brown; antennae dark brown; legs including tarsi dark brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 6). **Head:** Subspherical; integument closely punctate, somewhat dullish; frons convex, with median, round, shallow fovea above frontoclypeal region; apical margin of frontoclypeal region weakly trilobed,



about 2 times wider than base; mandibles stout, bidentate, densely punctate. **Antenna:** Filiform to weakly seriform from antennomeres III–XI, attaining nearly  $\frac{1}{3}$  the length of the body; antennomere III longer than IV; antennomeres IV–V each sub-equal, longer than wide, each slightly shorter than VI; antennomeres VI–X each sub-equal, longer than wide; antennomere XI stout, slightly longer than X, less than 2.0 times longer than wide. **Pronotum:** Integument dullish, densely punctate to rugose; longer than wide, with moderate, sharp hind angles; lateral sides basally constricted above pronotal hind angles, parallel-sided, cranially arcuate; disc convex with shallow median groove and pair of shallow, circular fovea; base sinuous. **Scutellar shield:** Elongate, sub-triangular, setose, shallowly punctate and distally rounded. **Elytra:** Distinctly striate; interstices elevated; integument somewhat shiny, transversely rugose at basal  $\frac{1}{2}$ , closely punctate at apical  $\frac{1}{2}$ . **Legs:** First tarsomere as long as the combined lengths of the remaining four on meso- and metatarsi; tibiae rounded in cross section; metatarsomeres I–III simple; metatarsomere IV excavate-emarginate; metatarsomere V short with simple claws. **Venter** (Fig. 7): Closely punctate, with short, recumbent yellowish setae; hypomeron with basally obliterated lateral antennal grooves; strongly-developed femoral ridge incomplete, elongate, extending about  $\frac{1}{2}$  the length of the hypomeral base; metepisterna parallel-sided; elytral epipleura punctate; metacoxal plates medially more than 3.0–6.0 times wider than laterally; last abdominal ventrite apically produced. **Aedeagus** (Fig. 8): Basal piece longer than wide, laterally parallel-sided, dorsally open, apically rounded; remaining parts elongate, constricted laterally just above the basal piece, laterally sinuous; parameres elongate, apically rounded, triangular-shaped lateral tooth present near apices; median lobe elongate and narrow, apically pointed, deeply and narrowly bifid, longer than parameres.

**Distribution.** This widespread, somewhat common eucnemid species has been taken from Alabama, Arkansas, Connecticut, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia (Otto and Karns 2017).

**Biology.** Specimens were reared from dead *Carya* sp. Nutt. (Juglandaceae) limbs as well as captured in Lindgren funnel traps and other types of flight intercept traps. Five specimens were taken from lights or blacklights in Florida. Two other specimens were beaten from a dead oak limbs. Immature stages were briefly noted by Van Horn (1909), but never formally described.

### *Nematodes collaris* Bonvouloir, 1872

Fig. 9–11

*Nematodes collaris* Bonvouloir 1872: plate 31, fig. 9; 1875: 663–664

**Diagnosis.** Very short, poorly-developed, incomplete femoral ridge at the base of the hypomera will readily distinguish *N. collaris* from all other *Nematodes* species present in the region.

**Specimens examined.** Ten specimens were available for study: **FLORIDA:** “FLORIDA: Alachua Co., NW Gainesville, 1-IV-1974, J.B. Heppner” / “*Nematodes, collaris*, Bonvouloir, Det. R.L. Otto, 2019” (1, FSCA). **ILLINOIS:** “ILLINOIS: St. Clair County, 1.1 km NNW East St. Louis, 36.63384, -90.15347, 128m, 2–14 Jun 2016, Lindgren FT, S. Mills, BSF# 71866” (1, GERP); “ILLINOIS St. Clair Co., 1.1 km NNW East St. Louis, 36.63384, -90.15347, 128m, 14–30 Jun 2016, LFT, S. Mills, BSF# 71543” (1, GERP). **INDIANA:** “Indiana: Morgan Co., June 12–July 10, 2009, purple sticky trap, Kyle E. Schnepf” / “*Nematodes, collaris*, Bonvouloir, Det. R.L. Otto, 2014” (1, KESC); “Indiana: Montgomery Co., Shades State Park, June 13–July 1, 2013, Lindgren funnel trap, Kyle E. Schnepf” (1, KESC). **OHIO:** “OHIO, Scioto Co., Shawnee St. For., IX-1980” (“IX-” and “80” were handwritten) / “collectors:, B&BValentine” / “Valentine, Coll’n, Rec. 2016” / “*Nematodes, collaris*, Bonvouloir, Det. R.L. Otto, 2019” (2, FSCA); “OHIO: Sandusky Co., 1.4 km NNW Clyde, 41.3153, -82.9843, 200m, 14–30 June 2016, LFT, C. Poe, BSF#68617” / “*Nematodes, collaris*, Bonvouloir, Det. R.L. Otto, 2017” (1, CMNH); “OHIO: Lucas County, 4.8 km SSW Sylvania, 41.6792, -83.7361, 250m, 22 Jun–5 Jul 2016, LFT, C. Poe, BSF# 68323” (1, GERP); “OHIO: Huron County, 0.8 km WSW Willard, 41.0514, -82.7373, 285m, 26 Jun–19 Jul 2018” / “cross-vane panel, trap, C. Mitchell, BSF#82591” (1, CMNH).

**Redescription.** Length, 6.5–9.0 mm. Width, 1.0–2.0 mm. Body subcylindrical, elongate; either uniformly dark brown-black or bicolored with dark orange head/pronotum and dark brown-black elytra/venter; antennae dark brown; legs including tarsi dark brown; head, pronotum and elytra clothed with short, recumbent yellowish

setae (Fig. 9). **Head:** Subspherical; integument closely punctate, somewhat dullish; frons convex, with median, round, deep fovea above frontoclypeal region; apical margin of frontoclypeal region weakly trilobed, about 2 times wider than base; mandibles stout, bidentate, densely punctate. **Antenna:** Filiform to weakly serriform from antennomeres III–XI, attaining nearly  $\frac{1}{3}$  the length of the body; antennomere III longer than IV; antennomeres IV–V each sub-equal, longer than wide, each slightly shorter than VI; antennomeres VI–X each sub-equal, longer than wide; antennomere XI elongate, longer than X, more than 2.0 times longer than wide. **Pronotum:** Integument dullish, densely punctate to rugose; longer than wide, with moderate, sharp hind angles; lateral sides parallel-sided, cranially arcuate; disc convex with deep median groove and pair of deep, circular fovea; base sinuous. **Scutellar shield:** Elongate, sub-triangular, setose, shallowly punctate and distally rounded. **Elytra:** Distinctly striate; interstices elevated; integument somewhat shiny, transversely rugose at basal  $\frac{1}{2}$ , closely punctate at apical  $\frac{1}{2}$ . **Legs:** First tarsomere as long as the combined lengths of the remaining four on meso- and metatarsi; tibiae rounded in cross section; metatarsomeres I–III simple; metatarsomere IV excavate-emarginate; metatarsomere V short with simple claws. **Venter** (Fig. 10): Closely punctate, with short, recumbent yellowish setae; hypomeron with basally obliterated lateral antennal grooves; poorly-developed femoral ridge, short, incomplete, extending about  $\frac{1}{3}$  the length of the hypomeral base; metepisterna parallel-sided; elytral epipleura punctate; metacoxal plates medially more than 3.0–6.0 times wider than laterally; last abdominal ventrite apically produced. **Aedeagus** (Fig. 11): Basal piece longer than wide, laterally parallel-sided, dorsally open, apically rounded; remaining parts elongate, parallel-sided; parameres elongate, apically rounded, triangular-shaped lateral tooth present near apices; median lobe elongate and narrow, apically pointed, deeply and narrowly bifid, longer than parameres.

**Distribution.** This very rarely seen eucnemid species was previously recorded in Illinois, Indiana, Kansas, Louisiana, Maryland, Ohio, South Carolina (Otto and Karns 2017) and now newly recorded for the first time in Florida. A single specimen from Missouri was misidentified as *N. collaris*. There are currently no Missouri records for the species.

**Biology.** Adult specimens were taken from Lindgren funnel traps, purple sticky trap, cross-vane panel trap, canopy traps, flight intercept traps, and canopy Malaise traps. Immature stages remain unknown.

**Note.** According to Muona (pers. comm.), the editors had accidentally switched the illustrations of the aedeagus between this species and that of *N. humphreyi* in the 2000 Nearctic revision of the family.

### *Nematodes humphreyi* Muona, 2000

Fig. 12–14

*Nematodes humphreyi* Muona 2000: 102

**Diagnosis.** Complete femoral ridge extending to the lateral side of the pronotum will distinguish *N. humphreyi* from all known *Nematodes* species present in the Nearctic region.

**Specimens examined.** Twenty-one specimens were available for study: **FLORIDA:** “FLORIDA: Dade Co., Camp Mahachie, nr., Matheson Hammock, 12-IV-1991, J. Gleason, Blacklight trap” (1, GERP); “FLORIDA: Miami-Dade Co., Miami, Greynolds Park West, 25.944, -80.1556, 5-V-2011, P. Perez, M. YongCong, J. Garcia, lindgren funnel trap w/ phoebe oil” (1, FSCA); “FLORIDA: Broward Co., Dania Beach, Secret, Woods Nature Ctr., 19-IV-2013, M. DaCosta, J. Garcia Stickyboard trap” (1, FSCA); Florida: Monroe Co., Upper Key Largo, May 25, 2014 at light, Kyle E. Schnepf” / “*Nematodes, humphreyi*, Muona, Det. R.L. Otto, 2014” (1, KESC); “Florida: Monroe Co., Upper Key Largo, May 15, 2016 stump, of small tree at night, Kyle E. Schnepf” (1, GERP; 4, KESC); “Florida: Monroe Co., Upper Key Largo, May, 15, 2016 at light, Kyle E. Schnepf” (1, KESC); “Florida: Monroe Co., Upper Key Largo, May 29, 2016 at light, Kyle E. Schnepf” (1, GERP; 1, KESC); “Florida: Monroe Co., Upper Key Largo, May 30, 2016 at light, Kyle E. Schnepf” (1, GERP; 5, KESC); “Florida: Monroe Co., Upper Key Largo, May 30, 2016, on cut tree at night, Kyle E. Schnepf” (2, KESC); “Florida: Monroe Co., Upper Key Largo, May 18, 2018 at light, Kyle E. Schnepf” (1, KESC).

**Redescription.** Length, 5.0–7.5 mm. Width, 1.0–2.0 mm. Body subcylindrical, elongate; uniformly dark brown; antennae dark reddish-brown; legs including tarsi dark reddish-brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 12). **Head:** Subspherical; integument closely punctate/rugose to confluent



**Figures 12–17.** *Nematodes* species. **12)** *Nematodes humphreyi* Muona, male, dorsal habitus. **13)** *Nematodes humphreyi* Muona, male, ventral habitus. **14)** *Nematodes humphreyi* Muona, male, aedeagus, dorsal. **15)** *Nematodes penetrans* (LeConte), female, dorsal habitus. **16)** *Nematodes penetrans* (LeConte), female, ventral habitus. **17)** *Nematodes penetrans* (LeConte), male, aedeagus, dorsal. (Scale: 12–13 = 5.0 mm; 14–17 = 1.0 mm.)

rugose, somewhat dullish; frons convex, with median, round, shallow fovea above frontoclypeal region; apical margin of frontoclypeal region weakly trilobed, about 2 times wider than base; mandibles stout, bidentate, densely punctate. **Antenna:** Filiform to weakly serriform from antennomeres III–XI, attaining nearly  $\frac{1}{3}$  the length of the body; antennomere III longer than IV; antennomeres IV–V each sub-equal, slightly longer than wide, each shorter than VI; antennomeres VI–X each sub-equal, longer than wide; antennomere XI elongate, slightly longer than X, more than 2.0 times longer than wide. **Pronotum:** Integument somewhat dullish, densely punctate to rugose; longer than wide, with moderate, sharp hind angles; lateral sides parallel-sided at basal half, arcuate at cranial  $\frac{1}{2}$ ; disc convex with shallow median groove extending through entire length and pair of shallow, circular fovea; base sinuous. **Scutellar shield:** Elongate, sub-triangular, setose, shallowly punctate and distally rounded. **Elytra:** Distinctly striate; interstices elevated; integument somewhat shiny, transversely rugose throughout. **Legs:** First tarsomere as long as the combined lengths of the remaining four on meso- and metatarsi; tibiae rounded in cross section; metatarsomeres I–III simple; metatarsomere IV excavate-emarginate; metatarsomere V short with simple claws. **Venter** (Fig. 13): Closely punctate, with short, recumbent yellowish setae; hypomeron with indicated, medially undefined lateral antennal grooves; well-developed femoral ridge complete, extending to the

lateral side of the pronotum; metepisterna parallel-sided; elytral epipleura punctate; metacoxal plates medially more than 3.0–6.0 times wider than laterally; last abdominal ventrite apically produced. **Aedeagus** (Fig. 14): Basal piece longer than wide, laterally parallel-sided, dorsally open, apically rounded; remaining parts elongate, basally bulbous above basal piece, laterally sinuous; parameres elongate, apically rounded, hook-like lateral tooth present base of parameres; median lobe elongate and narrow, apically pointed, deeply and narrowly bifid, slightly longer than parameres.

**Distribution.** This precinctive Florida eucnemid species is known from a small number of locations in southern Florida.

**Biology.** One specimen has been taken from a blacklight trap in Dade County. Two specimens were taken from a small cut tree at night. Eleven specimens were taken from lights in the Upper Key Largo. Five specimens were taken from a stump of a small tree at night. Immature stages remain unknown.

**Note.** According to Muona (pers. comm.), the editors had accidentally switched the illustrations of the aedeagus between this species and that of *N. collaris* in the 2000 Nearctic revision of the family.

### *Nematodes penetrans* (LeConte, 1852)

Fig. 15–17

*Emathion penetrans* LeConte 1852: 47

**Diagnosis.** A strongly-developed, elongate, incomplete femoral ridge will distinguish this eucnemid species from all known *Nematodes* species in the Nearctic region, except *N. rugosipennis* **new species**. A sub-equal antennomere V in relation to antennomere IV will further distinguish *N. penetrans* from *N. rugosipennis* **new species**.

**Specimens examined.** Three hundred and seventy-five specimens were available for study: **CANADA: QUÉBEC:** “CANADA: Quebec, Oka, 4 July 1999, Robert Vigneault” (1, GERP). **USA: ARKANSAS:** “AR Little Rock, VI/20/03Hanging, sugar traps, Brian Baldwin” (1, GERP). **ILLINOIS:** “ILLINOIS: Clinton County, 6.2 km SSW Harbor Light, Bay, 38.66203, -89.32758, 141m, 25 May–8 Jun 2018, S. Mills, LFT, BSF#82133” (1, CMNH); “ILLINOIS: St. Clair Co., 2.4 km WNW Signal Hill, 38.583173, -90.083133, 124 m, 8–22 Jun 2018, S. Mills, LFT, BSF#82234” (1, CMNH); “ILLINOIS: Moultrie County, 4.6 km ESE Kirksville, Forest W. Wood Access, Area, 39.55210, -88.62136, 194 m, 13–27 Jun 2018” / “Lindgren funnel, trap, C. Wetzels, BSF#81099” (1, CMNH). **INDIANA:** “Indiana: Tippecanoe Co., July 3–6, 2007 red, Lindgren funnel trap, Kyle E. Schnepf” (3, KESC); “Indiana: Tippecanoe Co., July 25–27, 2008, white PVC trap, Kyle E. Schnepf” (1, KESC); “Indiana: Tippecanoe Co., ex: dead butternut, Juglans cinerea branch, Kyle E. Schnepf” / “wood collected fall, 2009 emerged, spring 2010” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2019” (1, KESC). **KANSAS:** “USA: Kansas: Jefferson Co., The Falin Property, 1.5 km, N jct. 94<sup>th</sup> St. & Kingman, Rd. 39°13.38’N 95°24.24’W, 10–20-VI-2006 Z.H. Falin, ex. canopy FIT, near lower, meadow KAN1F05 118” (1, GERP). **MAINE:** “MAINE: Penobscot Co., 3.8km W Bangor, 52 m, 44.79578, -68.8247, 16–30 Jul 2018, LFT, R. Nyce, BSF#81958” (1, CMNH). **MISSOURI:** “MISSOURI: St. Louis Co., 2.4 km E Maryland Heights, 38.71261, -90.40263, 193m, 14–27 June 2016, LFT, L. Trevathan, BSF#70244” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2017” (2, CMNH). **NEW JERSEY:** “NEW JERSEY: Monmouth, Co., 1.2km S Farmingdale, 40.18605, -74.16875, 30m, 26 Jun–9 Jul 2018, LFT, D. Armstrong, BSF#80353” (1, CMNH). **NEW YORK:** “NEW YORK: Franklin Co., 6.2 km ENE Hogansburg, 44.9875, -74.5869, 48 m, 2–19 Jul 2019, LFT, A. Johnson, BSF#86283” (1, CMNH); “NEW YORK: Franklin Co., 0.9 km ENE Hogansburg, 44.9728, -74.6517, 60 m, 3–18 Jul 2019, LFT, A. Johnson, BSF#86310” (1, CMNH); “NEW YORK: Franklin Co., 7.5 km ENE Hogansburg, 44.9484, -74.5748, 62 m, 14–21 Aug 2019, LFT, A. Johnson, BSF#88005” (1, CMNH); “NEW YORK: Franklin Co., 5.2 km ENE Hogansburg, 44.9574, -74.6012, 66 m, 14–21 Aug 2019, LFT, A. Johnson, BSF#88019” (1, CMNH). **OHIO:** “OHIO: Hamilton County, 4.1km W Forest Park, 39.2884, -84.551, 258m, 12–28 Jun 2018, LFT, E. Larue, BSF#82508” (5, CMNH). **VERMONT:** “Vermont Orleans Co., Newport, PT-3; Jules Rd; N44.9853, W72.12628; EAB Purple Trap, Emerald Ash Borer Pheromone; 5/30/2014–7/21/2014; Coll., USDA (5535)” / “Eucnemidae, Eschscholtz 1829, Det. E.R. Hoebeke, 2015” (5, CMNH); “VERMONT: Chittenden, Co, 2.1km NNE Burlington, 44.494317, -73.208966, 33m, 7–29 Jun 2018” / “panel intercept, trap, E. Inoue, BSF#80820” (4, CMNH); “VERMONT: Windham Co., 2.5 km NW

Rockingham, 43.20408, -72.51019, 150m, 26 Jun–10 Jul 2018, LFT, L. Modesto, BSF#80319” (1, CMNH). **VIRGINIA:** “VA: Appomattox Co., Appomattox, 14–28 June 1999, Robert Vigneault” (1, GERP). **WEST VIRGINIA:** “WEST VIRGINIA: Raleigh, Co, 7 km ENE Beckley, 37.7937, -81.1116, 747m, 6–18 Jul 2018, LFT, R. Hays, BSF#80665” (1, CMNH). **WISCONSIN:** “Jackson Co., WI, T21N R24W s23, 27 VI–3 VII 1977, Gypsy Moth-M.T.” (handwritten) (1, WIRC); “USA: WI: Green Co., Abraham’s Woods SNA, 42°41’05”N/89°29’04”W, 11 July–5 Aug. 2001, Jeffrey P. Gruber” / “flight intercept trap near, several fallen trees in, southern mesic hardwood, forest” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2015” (1, WIRC); “USA: WI: Grant County, Wyalusing State Park, 42°59.647’N, 91°06.648’W, 18 – 26 July 2004, Coll. John J. Dorshorst” / “Flight intercept trap, baited with cantharidin, in southern mesic to, southern dry-mesic forest” (3, WIRC); “WI: Oconto Co., Rueckert’s private property, T29N R16E sec 16, 17 July 1996, Robert L. Otto” / “collected on, dead *Acer*” (1, GERP); “WI: Oconto Co., Rueckert’s private property, T29N R 17E sec 16, 14 July 1997, Robert L. Otto” / “collected beneath, *Acer* bark” (3, GERP); “WI: Richland Co., LWRWSA, Lone Rock Unit, T8N/R3E/Sec. 3, July 1–5 1999, Alistair Ramsdale” / “Flight intercept, Trap, Oak, savanna” (1, GERP); “WI: Sauk Co., Pine Hollow, T10N/R5E/Sec.4, July 7–13 1999, Alistair Ramsdale” / “Flight intercept, Trap, Mesic, Hardwood forest” (1, GERP); “WI: Fond du Lac Co., Long Lake, Kettle Moraine St. For., N43.66355°, W088.1652°, July 20, 2004, MDD & JMP” / “Girdled ash tree, EAB TT#1” (handwritten) (1, WIRC); “WI: Oconto Co., Rueckert’s private property, T29N R16E sec 16, 10 April 2007, Robert L. Otto” / “reared from larvae, in rotten *Acer* on, 13 May 2007” (1, GERP); “WI: Oconto Co., Rueckert’s private property, N44°59’ W88°25’, 9 April 2009, Robert L. Otto” / “reared from larva, in *Acer* on, 7 May 2009” (10, GERP); “WI: Oconto Co., Rueckert’s private property, N44°59’ W88°25’, 9 April 2009, Robert L. Otto” / “reared from larva, in *Acer* on, 9 May 2009” (2, GERP); “WI: Oconto Co., Rueckert’s private property, N44°59’ W88°25’, 9 April 2009, Robert L. Otto” / “reared from larva, in *Acer* on, 16 May 2009” (1, GERP); “WI: Forest Co., along County Hwy W, N45.54697°/W088.87092°, 14 July 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, GERP; 1, WIRC); “WI: Forest Co., along Interstate 8, N45.64411°/W088.66409°, 21 July 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (2, GERP; 2, WIRC); “WI: Forest Co., along State Hwy 139, N45.76769°/W088.69083°, 4 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, GERP; 1, WIRC); “WI: Forest Co., along County Hwy W, N45.54697°/W088.87092°, 11 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, GERP; 4, WIRC); “WI: Forest Co., along Range Line Rd., N45.60146°/W088.93555°, 11 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, GERP; 1, WIRC); “WI: Forest Co., along Lundt Rd., N45.58689°/W088.86453°, 11 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Potawatomi Trl., N45.56523°/W088.86207°, 11 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Otter Creek Ln., N45.60744°/W088.80075°, 12 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, GERP; 2, WIRC); “WI: Forest Co., along Peshtigo Preserve Rd, N45.56194°/W088.57435°, 17 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (4, WIRC); “WI: Forest Co., along Goodman Park Rd., N45.52111°/W088.564901°, 17 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Interstate 8, N45.64411°/W088.66409°, 18 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (3, GERP; 12, WIRC); “WI: Forest Co., along Peshtigo River Rd., N45.60692°/W088.59950°, 18 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Browns Rd., N45.65729°/W088.59246°, 18 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Forest Co., along Interstate 8, N45.65477°/W088.59246°, 18 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Forest Co., along Spur Ln., N45.64630°/W088.56099°, 19 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (4, WIRC); “WI: Forest Co., along County Hwy G, N45.65222°/W088.78085°, 19 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Forest Co., along S. Town Rd., N45.65641°/W088.56300°, 19 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Kalata Rd., N45.67459°/W088.65600°, 19 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Double Bend Rd., N45.74372°/W088.72631°, 20 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Hanson Flat, N45.66603°/

W088.96741°, 24 August 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Windsor Dam Rd., N45.86884°/W088.88438°, 1 September 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Forest Co., along Lundt Rd., N45.58689°/W088.86455°, 3 September 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (3, WIRC); “WI: Forest Co., along County Hwy W, N45.54697°/W088.87097°, 3 September 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Potawatomi Trl., N45.56523°/W088.86207°, 8 September 2009, Andy E. Anderson” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Interstate 8, N45.64411°/W088.66409°, 9 September 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Forest Co., along Browns Rd., N45.65729°/W088.59246°, 9 September 2009, Robert L. Otto” / “Taken from EAB, Prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T014697, N44.98045055°, W087.31120038°, September 21, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, GERP; 1, WIRC); “WI: Door Co., EAB Trap #T015991, N45.14915940°, W087.15348867°, September 21, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (3, WIRC); “WI: Door Co., EAB Trap #T015651, N45.11035387°, W087.21469416°, September 21, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T014541, N44.95521801°, W087.36600042°, September 21, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (4, WIRC); “WI: Door Co., EAB Trap #T014239, N44.92717752°, W087.3908807°, September 21, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T017944, N45.40686160°, W086.87317260°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Door Co., EAB Trap #T017477, N45.348739948°, W086.87006073°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Door Co., EAB Trap #T016989, N45.28424241°, W087.06588454°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Door Co., EAB Trap #T016658, N45.23784128°, W086.98765598°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T015993, N45.14882656°, W087.09470211°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Door Co., EAB Trap #T015652, N45.12242680°, W087.19298151°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (8, WIRC); “WI: Door Co., EAB Trap #T016159, N45.17046310°, W087.12216558°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T015656, N45.11044281°, W087.06869499°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T015483, N45.08630276°, W087.19392263°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (3, WIRC); “WI: Door Co., EAB Trap #T015484, N45.08352122°, W087.16285209°, September 22, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (3, WIRC); “WI: Door Co., EAB Trap #T014704, N44.98264829°, W087.22309529°, September 24, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, GERP; 3, WIRC); “WI: Door Co., EAB Trap #T015012, N45.02535123°, W087.28214468°, September 24, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Door Co., EAB Trap #T015168, N45.04545975°, W087.25530423°, September 24, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (1, WIRC); “WI: Door Co., EAB Trap #T014241, N44.91611643°, W087.33672235°, September 24, 2009, Robert L. Otto” / “Taken from EAB, prism trap baited, w/ Manuka oil” (2, WIRC); “WI: Shawano Co., along County Road C, N44.73930°. W-088.33105°, EABT012765, 21 June 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP); “WI: Oconto Co., along County Road G/M, N45.00425°. W-088.24133°, EABT014676, 29 June 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP); “WI: Marinette Co., along County Road C, N45.40716°. W-088.34933°, EABT017771, 1 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP); “WI: Marinette Co., along County Road F, N45.39204°, W-088.35157°, EABT017607, 1 July 2010, Robert L. Otto” / “Taken from EAB, Prism trap baited, with Manuka oil” (1, WIRC); “WI: Lafayette Co., along County Road U, N42.54630°. W-090.23315°, EABT108073, 7 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP; 36, WIRC); “WI: Lafayette Co., along County Road O, N42.52951°. W-090.25043°, EABT108146, 8 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP); “WI: Shawano Co., along

County Road M, N44.76789°, W-088.69987°, EABT012934, 12 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP; 1, WIRC); “WI: Shawano Co., along Maple Road, N44.77976°, W-088.67004°, EABT013102, 12 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP; 3 WIRC); “WI: Marinette Co., along Packard Road, N45.33680138°, W-087.69561374°, EABT017300, 12 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Marinette Co., along Forest Road 901, N45.32403046°, W-087.83637892°, EABT017112, 12 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Chapin Road, N45.33556528°, W-087.68496905°, EABT017476, 12 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Shawano Co., along Cherry Road, N44.82852°, W-088.72285°, EABT013439, 13 July 2010, Robert L. Otto” / Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Shawano Co., along Hickory Road, N44.80491°, W-088.71557°, EABT013284, 13 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Rock Co., along S. Johnson Road, N42.645037°, W-089.13047997°, EABT107501, 14 July 2010, Victor Starostka” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Shawano Co., along Woods Road, N44.84645°, W-088.52161°, EABT025222, 15 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Shawano Co., along Old Lakes Road, N44.81015°, W-088.58273°, EABT013288, 15 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Shawano Co., along Industrial Drive, N44.76722°, W-088.57491°, EABT012938, 15 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Nejedlo Road, N45.35224772°, W-088.01709023°, EABT017291, 15 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Shawano Co., along Cheese Factory Road, N44.84477°, W-088.42981°, EABT013600, 19 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Pike River Road, N45.38102841°, W-087.89911386°, EABT017622, 19 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Green Co., along Mt. Hope Road, N42.50737103°, W-089.39527133°, EABT108122, 21 July 2010, Larry Broitzman” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along County Road R, N44.87707°, W-088.45058°, EABT013758, 21 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Green Co., along Mt. Hope Road, N42.50737103°, W-089.39527133°, EABT108122, 21 July 2010, Larry Broitzman” / “Taken from EAB, prism trap baited, with Manuka oil” (1, GERP); “WI: Marinette Co., along Point Lane, N45.24940663°, W-087.891258°, EABT016635, 24 July 2010, Randy LaPlant” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along Brush Lane, N45.00051°, W-088.45244°, EABT014669, 26 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along Pine Road, N44.96420°, W-088.43286°, EABT014360, 26 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along Peshtigo Brook Road, N45.01746°, W-088.36530°, EABT014807, 26 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along County Road M, N45.00508°, W-088.29438°, EABT014674, 27 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along County Roads G & M, N45.00425°, W-088.24133°, EABT014676, 27 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along Rugg Road, N45.30374°, W-088.54252°, EABT016959, 27 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Oconto Co., along Tillman Road, N44.98399°, W-088.33889°, EABT014512, 27 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Green Co., along County Road EE, N42.7408787°, W-089.48130059°, EABT106993, 28 July 2010, Larry Broitzman” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Kirby Lake Road, N45.22294°, W-088.11060°, EABT016297, 28 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Marinette Co., along Brandywine Lane, N45.40898°, W-088.31567°, EABT017772, 29 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Parkway Road, N45.30199°, W-088.20638°, EABT016970, 29 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (1, WIRC); “WI: Marinette Co., along Bluebird Road, N45.39176°, W-088.32729°, EABT017608, 29 July 2010, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil” (2, WIRC); “WI: Marinette Co., along Eagle River Road,

N45.43129°, W-088.23354°, EABT017910, 29 July 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along Country Road F, N45.39204°, W-088.35157°, EABT017607, 29 July 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along Boat Landing no. 13 Road, N45.34381°, W-088.22379°, EABT017284, 29 July 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along Ranch Road, N45.320095°, W-088.23276°, EABT017104, 29 July 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Vilas Co., July 2010, Marie Eicksen-Pilch" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Rusk Co., July 2010, Marie Eicksen-Pilch" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along County Road VV, N42.73084°, W-091.01829°, EABT025487, 2 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (11, WIRC); "WI: Grant Co., along County Road VV, N42.74561°. W-091.03953°, EABT025486, 2 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, GERP); "WI: Grant Co., along Birchwood Lane, N42.55105°, W-090.61307°, EABT108134, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (2, WIRC); "WI: Grant Co., along Kelly Lane, N42.65854°, W-090.64565°, EABT107667, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along Indian Creek Road, N42.61946°, W-090.63913°, EABT107901, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., Potosi Recreation Area, N42.66558°, W-090.72927°, EABT107664, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., Grant River Recreation Area, N42.65148°, W-090.70064°, EABT107665, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along River Lane, N42.64566°, W-090.69144°, EABT000802, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (2, WIRC); "WI: Grant Co., O'Leary's Lake Recreation Area, N42.54082°, W-090.63676°, EABT000151, 3 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (4, WIRC); "WI: Grant Co., along Far-Nuff Road, N42.69210°, W-090.90461°, EABT107550, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., K-7 Korral Campground, N42.70224°, W-090.95731°, EABT10548, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along Closing Dam Road, N42.76075°, W-091.05850°, EABT107215, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (3, WIRC); "WI: Grant Co., along Burton Lane, N42.71818°, W-090.81564°, EABT107444, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (2, WIRC); "WI: Grant Co., along Lynn Hollow Lane, N42.67606°, W-090.81497°, EABT107661, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along Dutch Hollow Road, N42.70730°, W-090.78826°, EABT107445, 4 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along Airport Road, N42.77551°, W-090.67876°, EABT107117, 5 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Grant Co., along County Road O, N42.68338°, W-090.63218°, EABT107559, 5 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Shawano Co., along County Road M, N44.76789°, W-088.69987°, EABT012934, 9 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Oconto Co., along Peshtigo Brook Road, N45.01746°, W-088.36530°, EABT014807, 16 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Oconto Co., along Brush Lane, N45.00051°, W-088.45244°, EABT014669, 16 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along County Road C, N45.39984°, W-088.14449°, EABT017614, 24 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along County Road A, N45.42694°, W-088.10370°, EABT017914, 24 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along Davis Road, N45.41748°, W-088.08846°, EABT017779, 24 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Marinette Co., along Smith Creek Road, N45.26758°. W-088.05819°, EABT016630, 24 August 2010, Robert L. Otto" / "Taken from EAB, prism trap baited, with Manuka oil" (1, GERP; 2, WIRC); "WI: Rusk Co., August 2010, Marie Eicksen-Pilch" / "Taken from EAB, prism trap baited, with Manuka oil" (1, WIRC); "WI: Oneida Co., August 2010, Marie Eicksen-Pilch" / "Taken from EAB, prism trap baited, with



Manuka oil” (1, WIRC); “WI: Sauk Co., along Schiffet Road, N43.1677610°, W-090.078893°, EABT104953C, 11 July 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (2, WIRC); “WI: Grant Co., along Walnut Road, N42.9040730°, W-091.099555°, EABT106539, 14 July 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (3, WIRC); “WI: Waupaca Co., along County Road T, N44.42629°. W-088.75619°, EABT010405A, 21 July 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (2, GERP); “WI: Waupaca Co., along Big Eddy Road, N44.39886°. W-088.77316°, EABT010267A, 21 July 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (1, GERP); “WI: Waupaca Co., along Big Eddy Road, N44.39883°. W-088.77314°, EABT010267B, 21 July 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (3, GERP); “WI: Richland Co., along State Highway 60, N43.2070650°, W-090.565659°, EABT104865, 21 July 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (1, WIRC); “WI: Richland Co., along Country Lane, N43.3549120°, W-090.413616°, EABT104037C, 28 July 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (3, WIRC); “WI: Marinette Co., along H & S Lane, N45.37822°, W-088.26212°, EABT017450, 29 July 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (1, WIRC); “WI: Winnebago Co., along Mill Pond Lane, N44.22178°. W-088.47646°, EABT100276C, 15 August 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (1, GERP); “WI: Grant Co., along Bluff Road, N42.5388840°, W-090.622583°, EABT000151, 16 August 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (3, WIRC); “WI: Grant Co., along Dutch Hollow Road, N42.7041840°, W-090.770282°, EABT107446, 18 August 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (3, WIRC); “WI: Grant Co., along State Highway 133, N42.7039690°, W-090.943685°, EABT107549, 18 August 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (1, WIRC); “WI: Grant Co., along Pigeon River Road, N42.785030°, W-090.809306°, EABT107112, 23 August 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (1, WIRC); “WI: Grant Co., along Mississippi Drive, N42.8654220°, W-091.050628°, EABT106656, 24 August 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (5, WIRC); “WI: Grant Co., along Wightman Road, N43.1874800°, W-090.528244°, EABT104978, 6 September 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (4, WIRC); “WI: Richland Co., along State Highway 60, N43.2023310°, W-090.434931°, EABT104869D, 7 September 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (1, WIRC); “WI: Iowa Co., along State Highway 14, N43.1678660°, W-090.039619°, EABT104994B, 7 September 2011, Andy Anderson” / “Taken from EAB, prism trap baited, with Manuka oil, & Z3-Hexon-1-ol” (4, WIRC); “WI: Florence Co., along Brook Street, N45.82581°. W-088.24797°, EABT020739A, 7 September 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (1, GERP); “WI: Florence Co., along Brook Street, N45.82539°. W-088.24696°, EABT020739B, 7 September 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (1, GERP); “WI: Florence Co., along County Road N, N45.83457°. W-088.22651°, EABT020740A, 7 September 2011, Robert L. Otto” / “Taken from EAB, prism trap baited, with Manuka oil & Z3-Hexon-1-ol” (1, GERP); “WI: Oconto Co., along Groniger St., N44.998073°, W-088.378475°, 26 June – 13 July 2012, Robert L. Otto” / “Taken from elevated, flight intercept trap, baited with Manuka oil” (1, GERP); “USA: WI: Ozaukee Co., UW-Mil. Field Station, 43.38295°N/-88.02534°W, WGS84; 09–16 July 2013, Daniel K. Young; Malaise, Trap *Fagus-Acer* forest” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2015” (2, WIRC); “USA: WI: Langlade County, Gardner Dam BSA Camp, 45.13667°N/88.68449°W, WGS84; 13–20 July 2013, Kari Gullickson, Duane Hille, Malaise trap; hardwood forest” (1, WIRC); “USA: WI: Ozaukee Co., UW-Mil. Field Station, 43.38295°N/-88.02534°W, WGS84; 22–30 July 2013, Daniel K. Young; Malaise, Trap *Fagus-Acer* forest” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2015” (1, WIRC); “USA: WI: Ozaukee Co., UW-Mil. Field Station, 43.38295°N/-88.02534°W, WGS84; 13–20 August 2013, Daniel K. Young; Malaise, Trap *Fagus-Acer* forest” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2015” (1, WIRC); “USA: WI: Dodge Co., Ledge County Park, ~43.47357°N 88.57654°W, 28 June 2014, Jeffrey P. Gruber” / “found on mostly debarked, trunk of dead standing, hardwood tree, mixed, hardwood forest” / “*Nematodes, penetrans*, (LeConte), Det. R.L. Otto, 2016” (“16” handwritten) (1, WIRC); “USA: WI: Waukesha Co., Muskego Park, Hardwoods SNA, ~42.89587°N 88.16227°W, 5

July 2014, Jeffrey P. Gruber” / “crawling on large debarked, hardwood log, southern, dry-mesic forest” / “Nematodes, penetrans, (LeConte), Det. R.L. Otto, 2014” (7, WIRC); “WI: Oconto Co., Jeff Otto Property, N44° 59.075’, W-088° 28.725’, 5 April 2015, Robert L. Otto” / “Reared from larvae, in rotten Acer limb, on 8 May 2015” (1, GERP); “WI: Oconto Co., Jeff Otto Property, N44° 59.075’, W-088° 28.725’, 5 April 2015, Robert L. Otto” / “Reared from larvae, in rotten Acer limb, on 18 May 2015” (1, GERP); “WI: La Crosse Co., Coulee Exp. Forest, N43° 51.612’, W-91° 01.797’, 15 July 2015, Robert L. Otto” / “Taken from, downed elm, tree” (1, GERP); “USA: WI: Outagamie County, LaSage Bottom SNA, 44.38264°N/88.60455°W, 24 June–09 July 2016, WGS84; Ann Marsh” / “Non-baited Townes Malaise, Trap; second growth flood-, plain forest; shade, between, ephemeral pond and river; Specify Collection, Event Code, 2016AM0148” (1, WIRC); “USA: WI: Juneau County, 15 m E of Lemonwear River, 43.91632°N/90.16554°W, 27 June–11 July 2016, WGS84; Ann Marsh” / “Ocotopoda baited Lindgren, Funnel Trap; flood plain, forest; amid ephemeral, ponds and river; mixed, hardwood canopy; shade, Specify Collection, Event Code, 2016AM0152” (5, WIRC); “USA: WI: Outagamie County, LaSage Bottom SNA, 44.38264°N/88.60455°W, 09–25 July 2016, WGS84; Ann Marsh” / “Non-baited Townes Malaise, Trap; second growth flood-, plain forest; shade, between, ephemeral pond and river; Specify Collection, Event Code, 2016AM0171” (1, WIRC); “USA: WI: Juneau County, 15 m E of Lemonwear River, 43.91632°N/90.16554°W, 11–28 July 2016, WGS84; Ann Marsh” / “Ocotopoda baited Lindgren, Funnel Trap; flood plain, forest; amid ephemeral, ponds and river; mixed, hardwood canopy; shade, Specify Collection, Event Code, 2016AM0181” (1, WIRC).

**Redescription.** Length, 3.0–6.0 mm. Width, 1.0 mm. Body subcylindrical, elongate; uniformly black; antennae dark brown; legs including tarsi dark brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 15). **Head:** Subspherical; integument closely punctate, somewhat shiny; frons convex, with median, round, shallow fovea above frontoclypeal region; apical margin of frontoclypeal region weakly trilobed, about 2 times wider than base; mandibles stout, bidentate, densely punctate. **Antenna:** Filiform to weakly serriform from antennomeres III–XI, attaining nearly  $\frac{1}{3}$  the length of the body; antennomere III longer than IV; antennomeres IV–VI each sub-equal, slightly longer than wide, each slightly shorter than VII; antennomeres VII–X each sub-equal, longer than wide; antennomere XI slightly longer than X. **Pronotum:** Integument somewhat shiny, densely punctate to rugose; longer than wide, with moderate, sharp hind angles; lateral sides basally constricted above pronotal hind angles, parallel-sided, cranially arcuate; disc convex with short, shallow median groove and pair of shallow, circular fovea; base sinuous. **Scutellar shield:** Quadrate, setose, shallowly punctate and distally truncated. **Elytra:** Striae absent to weakly indicated; interstices flattened; integument somewhat shiny, transversely rugose at basal  $\frac{1}{3}$ , closely punctate at apical  $\frac{2}{3}$ . **Legs:** First tarsomere shorter than the combined lengths of the remaining four on meso- and metatarsi; tibiae rounded in cross section; metatarsomeres I–III simple; metatarsomere IV excavate-emarginate; metatarsomere V elongate with simple claws. **Venter** (Fig. 16): Closely punctate, with short, recumbent yellowish setae; hypomeron with basally obliterated lateral antennal grooves; strongly-developed femoral ridge incomplete, elongate, extending almost to the lateral side of the pronotum; metepisterna parallel-sided; elytral epipleura punctate; metacoxal plates medially more than 3.0–6.0 times wider than laterally; last abdominal ventrite apically produced. **Aedeagus** (Fig. 17): Basal piece longer than wide, laterally parallel-sided, dorsally open, apically rounded; remaining parts elongate, parallel-sided; parameres elongate, apically pointed, triangular-shaped lateral tooth present half way between base of and apices of the parameres; secondary lateral lobes present, short, attached at base of parameres; median lobe elongate and narrow, apically pointed, deeply and narrowly bifid, as long as the parameres.

**Distribution.** In Canada, this somewhat commonly collected, widespread eucnemid species has been taken in New Brunswick, Nova Scotia, Ontario, and Québec (Webster et al. 2012). In the United States, *N. penetrans* is known from Alabama, Arkansas (**New State Record**), Florida, Georgia, Illinois, Indiana, Iowa, Kansas (**New State Record**), Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Texas, Vermont, Virginia, West Virginia, and Wisconsin (Otto and Karns 2017).

**Biology.** Specimens were taken from a blacklight trap, white PVC trap, a Malaise trap, Lindgren funnel traps, a panel intercept trap, and cross-vane panel traps. Immature stages were documented by Otto (2017).

***Nematodes rugosipennis* Otto, new species**

Fig. 18–21

**Diagnosis.** A well-developed, elongate, incomplete femoral ridge will readily distinguish *N. rugosipennis* **new species** from most *Nematodes* species in the region, except *N. penetrans*. A shorter antennomere V in relation to antennomere IV will further distinguish the new species from *N. penetrans*.

**Type material. Female holotype:** “FLORIDA: ALACHUA COUNTY, GAINESVILLE, BEVILLE HTS, 19-III-80, L.A. STANGE, BLACKLIGHT TRAP” / “**HOLOTYPE:**, *Nematodes, rugosipennis* ♀, Otto, det. R.L. Otto, 2019” (red printed label). **Male allotype:** “Florida: Marion Co., ~4 miles E Ft. McCoy, April 26–June 15, 2015, Lindgren funnel trap, Kyle E. Schnepf” / “**ALLOTYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label). Holotype is deposited in FSCA. Allotype is deposited in KESC.

**Paratypes.** 17 ♂♂, 22 ♀♀: **FLORIDA:** 2 ♂♂ 1 ♀, “USA FLORIDA Columbia Co., O’Leno State Park, 01-V-96, Coll. Robert Vigneault” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE:**, *Nematodes, rugosipennis* ♂ (or ♀), Otto, Det. R.L. Otto, 2019” (yellow printed label) (3, GERP); 1 ♂, “USA FLORIDA Orange Co., Wekiwa Springs SP, 12-V-96, Coll. Robert Vigneault” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, GERP); 1 ♀, “FL: Polk Co., Green Swamp WMA, May 2001, Morris and Nigg, Malaise Trap” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, GERP); 2 ♀♀, “**USA: FL:** Wakulla Co.; Apalachicola; Nat. For.; FS 366; Pine/oak savanna; 15–20-MAY-2005; 30°19.751’N; 84°30.309’W; Deans & Murray; EX: “ant heaven” malaise trap” / **PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2020” (yellow printed label) (2, CDAE); 1 ♀, “USA: FL: Leon Co.; Apalachicola; NF; FS390; 30°21.884’N; 84°40.774’W; Mosquito Hell; Malaise trap; bottomlands; 21 – 28.V.2005; S. Joshi” / **PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2020” (yellow printed label) (1, CDAE); 1 ♂, “FLORIDA: Alachua, Co., Oleno State Park, 21-IV-2009, L.A. Wilby, EAB trap w/ Manula oil” / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, FSCA); 2 ♀♀, “FLORIDA: Wakulla Co., Ochlockowee Riv. St. Pk., 11-V-2009, L. Wilby, EAB trap w/ manuka oil” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (2, FSCA); 1 ♀, “FLORIDA: Alachua Co., O’Leno St. Pk., 27-V-2009, L. Wilby, EAB trap w/ manuka oil” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, FSCA); 2 ♂♂, “FLORIDA: Highlands Co., Highlands Hammock St. Pk., 27.47070, -81.55.254, 5-IV-2011, C. Carrero-Turnbull, D. Gaskilla, lindgren funnel, manuka oil” / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (2, FSCA); 2 ♂♂, “Florida: Alachua Co., San Felasco Preserve, April 5–May 6, 2014, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2021” (yellow printed label) (2, KESC); 3 ♀♀, “Florida: Alachua Co., 3.4 miles WNW Archer, March 30–June 12, 2015, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (3, KESC); 1 ♀, “Florida: Marion Co., ~4 miles E Ft. McCoy, March 21–April 26, 2015, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, KESC); 2 ♀, “Florida: Marion Co., ~4 miles E Ft. McCoy, April 26–June 15, 2015, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (2, KESC); 1 ♀, “Florida: Suwanee Co., ~7 miles W White Springs, March 29–April 19, 2017, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2021” (yellow printed label) (1, KESC); 1 ♀, “Florida: Suwanee Co., ~7 miles W White Springs, April 19–May 16, 2017, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2021” (yellow printed label) (1, KESC); 1 ♂, “FL: Polk co., 2635 E Ewell Rd., Lakeland, 16–26/II/2018, R. Morris, WPT” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, GERP); 3 ♂♂, “FL: Polk co., 2635 E Ewell Rd., Lakeland, 18–29/III/2018, R. Morris, WPT” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (3, GERP); 1 ♂, “FL: Polk co., 2635 E Ewell Rd., Lakeland, V/1–13, /2018, R. Morris, Window pane Trap” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label)



**Figures 18–21.** *Nematodes rugosipennis* Otto, **sp. nov.** **18)** Female holotype, dorsal habitus. **19)** Female holotype, ventral habitus. **20)** Male allotype, dorsal habitus. **21)** Male paratype, aedeagus, dorsal. (Scale: 18–20 = 5.0 mm; 21 = 1.0 mm.)

/ “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, GERP); 1 ♂, “Florida: Liberty Co., Torreya S.P. at light, May 11, 2018, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2021” (yellow printed label) (1, KESC); 1 ♂, “Florida: Alachua Co., San Felasco H.P.S.P., April 24–May 5, 2021, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2021” (yellow printed label) (1, KESC); 3 ♀♀, “Florida: Alachua Co., San Felasco H.P.S.P., April 24–May 5, 2021, Lindgren funnel trap, Kyle E. Schnepf” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2021” (yellow printed label) (3, KESC). **GEORGIA:** 1 ♀, “GEORGIA: Bibb County, 2.6 km SSW Walden, 32.68599, -83.67626, 108m, 29 Mar–13 Apr 2018, LFT, C. Barnes, BSF#78312” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2020” (yellow printed label) (1, CMNH); 1 ♀, “GEORGIA: Cook County, 4.7km E of Ellenton, 76m, 31.17202, -83.53825, 25 Apr–15 May 2018, LFT, N. Skaggs, BSF#85831” / “**PARATYPE:**, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2020” (yellow printed label) (1, CMNH). **OKLAHOMA:** 1 ♀, “OKLAHOMA Grady Co., Tuttle, VI/10/05, Lindgren traps, Brian Baldwin” / “Collection of the

Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Nematodes, rugosipennis* ♀, Otto, Det. R.L. Otto, 2019” (yellow printed label) (1, GERP); 2 ♂♂, “OKLAHOMA Grady Co., Tuttle, VI/22/05, Blacklight traps, Brian Baldwin” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Nematodes, rugosipennis* ♂, Otto, Det. R.L. Otto, 2019” (yellow printed label) (2, GERP). Paratypes are deposited in CDAE, CMNH, FSCA, GERP, and KESC.

**Description. Female holotype:** Length, 10.0 mm. Width, 2.5 mm. Body subcylindrical, elongate; uniformly pitch black; antennae dark brown; legs including tarsi dark brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 18). **Head:** Subspherical; integument confluent rugose, somewhat dullish; frons convex, with median, round, shallow fovea above frontoclypeal region; apical margin of frontoclypeal region weakly trilobed, about 2 times wider than base; mandibles stout, bidentate, densely punctate. **Antenna:** Filiform to weakly serriform from antennomeres III–XI, attaining nearly  $\frac{1}{3}$  the length of the body; antennomere III longer than IV; antennomeres IV–V each sub-equal, longer than wide, each slightly shorter than VI; antennomeres VI–IX each sub-equal, longer than wide; antennomere X slightly shorter than IX; antennomere XI stout, slightly longer than X, less than 2.0 times longer than wide. **Pronotum:** Integument dullish, densely granulate to rugose; longer than wide, with moderate, sharp hind angles; lateral sides basally constricted above pronotal hind angles, parallel-sided, cranially arcuate; disc convex with deep median groove and 2 pairs of deep, circular fovea; base sinuous. **Scutellar shield:** Elongate, sub-triangular, setose, shallowly punctate and distally rounded. **Elytra:** Distinctly striate; interstices elevated; integument somewhat shiny, transversely rugose. **Legs:** First tarsomere as long as the combined lengths of the remaining four on meso- and metatarsi; tibiae rounded in cross section; metatarsomeres I–III simple; metatarsomere IV excavate-emarginate; metatarsomere V elongate with simple claws. **Venter** (Fig. 19): Very closely punctate, with short, recumbent yellowish setae; hypomeron with basally obliterated lateral antennal grooves; well-developed femoral ridge incomplete, elongate, extending near the lateral side of the pronotum; metepisterna parallel-sided; elytral epipleura punctate; metacoxal plates medially more than 3.0–6.0 times wider than laterally; last abdominal ventrite apically produced.

**Male allotype** (Fig. 20). Length, 9.0 mm. Width, 2.0 mm. Antennae filiform to weakly serriform, reaching at least  $\frac{1}{3}$  the length of the body; habitus similar to holotype; legs and antennae dark brown; antennomere X is as long as antennomere IX; pronotum similar to holotype, except second pair of circular fovea posterolaterad of the first pair are absent; integument similar to holotype.

**Aedeagus (paratype)** (Fig. 21). Basal piece longer than wide, laterally parallel-sided, dorsally open, apically rounded; remaining parts elongate, constricted laterally just above the basal piece, laterally sinuous; parameres elongate, apically rounded, triangular-shaped lateral tooth present near apices; median lobe elongate and narrow, apically pointed, deeply and narrowly bifid, longer than parameres.

**Variation.** Seventeen male and 22 female paratypes were examined. Male paratypes measured 7.0–10.0 mm long and 1.5–2.0 mm wide. Female paratypes measured 6.0–11.5 mm long and 1.5–2.5 mm wide. Fifteen of the 22 female paratypes are shorter and narrower than the holotype. The three female paratypes are larger and wider than the holotype. The four remaining female paratypes are just as long as but slightly narrower than the holotype. All male paratypes are smaller and narrower than the holotype. Four of the 17 male paratypes is as long as and as wide as the allotype. Five male paratypes are longer than the allotype. Eight male paratypes are shorter than the allotype. Circular fovea on the pronotal disc are much deeper in seven of the 17 male paratypes and eight of the 22 female paratypes compared to the other paratypes, holotype, and allotype. All paratypes lack the second pair of circular fovea on the pronotum. Two male paratypes are brownish in color, possibly teneral at the time they were collected. There are no other exoskeletal difference between any paratypes, allotype, and the holotype.

**Distribution.** This eucnemid species is known from 41 specimens taken from a number of locations in Florida, two locales in Georgia and a single location in Oklahoma.

**Biology.** The holotype was taken from a blacklight trap placed in Gainesville, Florida. Eleven female paratypes, three male paratypes and male allotype were taken from Lindgren funnel traps deployed in Alachua, Marion, and Suwanee Counties, Florida. Five male paratypes were taken from a window pane trap deployed in Polk County, Florida. Two female paratypes were taken from “ant heaven” Malaise trap placed within a pine/oak savanna in Wakulla County, Florida. One female paratype was taken from a Malaise trap placed in bottomlands within Leon County, Florida. One female paratype was taken from a Malaise trap placed in Polk County, Florida.

One male and three female paratypes were taken from Emerald Ash Borer trap baited with Manuka oil in two Florida Counties. Two male paratypes were taken from Lindgren funnel trap baited with Phoebe oil in Highlands County, Florida. One male paratype was taken from light in Liberty County, Florida. Two female specimens were taken from Lindgren funnel traps placed in two locations in Georgia. Two male paratypes were taken from black-light in Oklahoma. One female paratype was taken from Lindgren funnel traps in Oklahoma. Immature stages remain unknown.

**Etymology.** The specific epithet is derived from its transversely rugose surfaces present throughout the elytral interstices.

**Note.** Basal sex combs present in male *Nematodes* species are often difficult to observe when examining specimens under magnification. Protarsomere I was observed to be shorter in male specimens compared to the length of protarsomere I in female specimens.

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## Literature Cited

- Bonvouloir HA. 1872.** Monographie de la Famille des Eucnémidés, 2nd part. Annales de la Société Entomologique de France (supplement) 40: 289–560, plates 22–36.
- Bonvouloir HA. 1875.** Monographie de la Famille des Eucnémidés, 3rd and 4th parts. Annales de la Société Entomologique de France (supplement) 40: 561–907, plates 37–42.
- LeConte JL. 1852.** Synopsis of the Eucnemides of temperate North America. Proceedings of the Academy of Natural Sciences of Philadelphia 6: 45–49.
- Muona J. 1993.** Review of the phylogeny, classification and biology of the family Eucnemidae (Coleoptera). Entomologica Scandinavica Supplement 44: 1–133.
- Muona J. 2000.** A revision of the Nearctic Eucnemidae. Acta Zoologica Fennica 212: 1–106.
- Muona J. 2011.** Eucnemidae.info Homepage. Available at [http://dol.luomus.fi:8080/cgi-bin/dol/dol\\_homepage.pl](http://dol.luomus.fi:8080/cgi-bin/dol/dol_homepage.pl) (Last accessed 6 April 2019.)
- Otto RL. 2016.** The false click beetles (Coleoptera: Eucnemidae) of Laos. Entomologica Basiliensia et Collectionis Frey 35: 181–427.
- Otto RL. 2017.** Eucnemid larvae of the Nearctic Region. Part VII: Description of the larvae of *Nematodes penetrans* (LeConte, 1852) (Coleoptera: Eucnemidae: Macraulacinae: Nematodini), with notes on its hypermetamorphic life cycle. Insecta Mundi 0545: 1–9.
- Otto RL, Karns KD. 2017.** New state records for Nearctic false click beetles (Coleoptera: Eucnemidae). Insecta Mundi 0582: 1–21.
- Say TA. 1836.** Descriptions of new North American insects and observations on some already described. Transactions of the American Philosophical Society 6(ns): 155–190.
- Van Horn RW. 1909.** Notes on some of the Eucnemidae of the eastern states. Proceedings of the Entomological Society of Washington 11: 54–61.
- Webster RP, Sweeny JD, DeMerchant I. 2012.** New Coleoptera records from New Brunswick, Canada: Eucnemidae. ZooKeys 179: 77–91.

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