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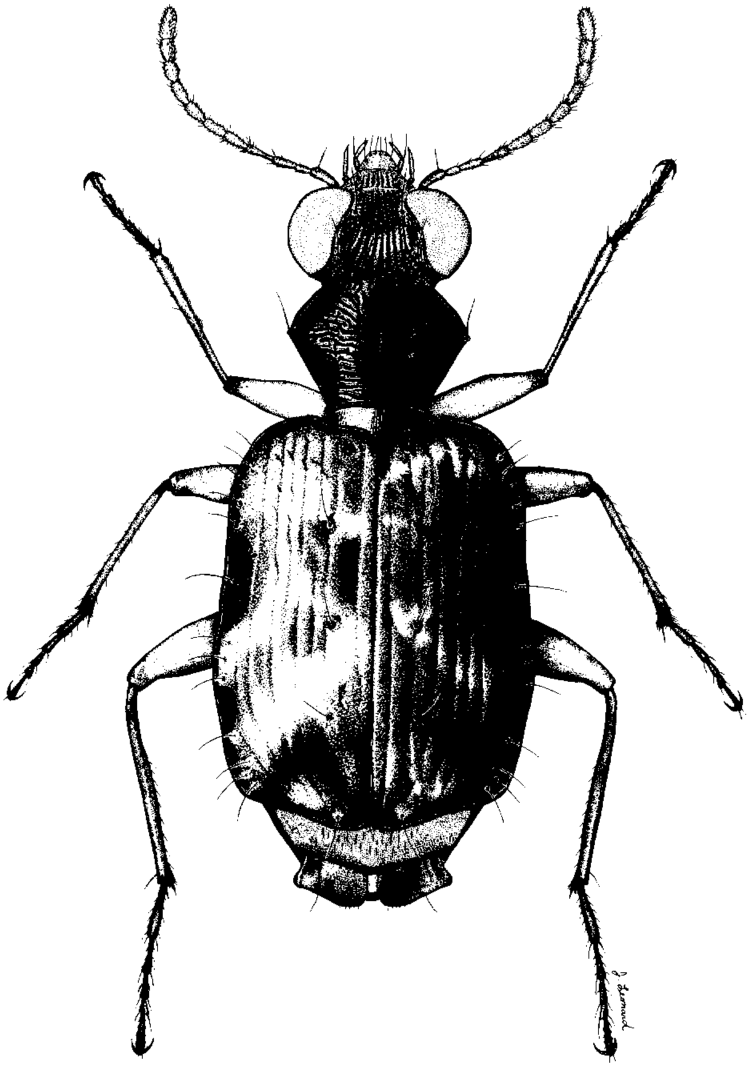

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REVISION OF THE GENUS *EUTRICHITES* LECONTE (COLEOPTERA: PSELAPHIDAE)[1]

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ABSTRACT

Eutrichites LeConte is defined and placed in the subtribe Pselaptina. The type-species, *E. zonatus* (Brendel), is redescribed, including a description of the egg. The following are described as new species: *E. arizonensis* from Arizona; *E. veracruzensis* from Veracruz, Mexico; and *E. buscki* from Panama. *Xybaris funiculis* Park is transferred to *Eutrichites* as a new combination, and the male is described. A cladogram of *Eutrichites* species is proposed, and the relationship of the genus to other pselaptine pselaphids is discussed.

Eutrichites LeConte (1880) was based by monotypy on *E. zimmermanni* LeConte, a species previously described as *Bythinus zonatus* Brendel (1865). *Bythinus* is a European genus belonging to a different tribe, Bythinini. Bowman (1934) noted the nomenclatural priority of *E. zonatus* and reduced *E. zimmermanni* to a junior synonym. *Eutrichites zonatus,* the type-species, is widespread throughout the eastern United States and southeastern Canada.

Eutrichites belongs to a cluster of primarily neotropical and Middle American genera within the tribe Brachyglutini. This cluster is equivalent to the subtribe Pselaptina of Park *et al.* (1976) and includes, in addition to *Eutrichites, Xybaris* Reitter, *Xybarida* Raffray, *Pselaptus* LeConte, *Scalenarthrus* LeConte, *Cryphorhinula* Schaufuss, and possibly *Caligocara* Park. *Scalenarthrus* is the largest of these genera with 20 described species distributed from Brazil and the West Indies to the southwestern United States. The Pselaptina may be loosely characterized as brachyglutine pselaphids having a somewhat globose habitus; elytra lacking discal striae; metacoxae distant; and a carinal pattern on the ventral aspect of the head that consists of a median carina, paired sigmoid lateral carinae, and paired subocular carinae (Fig. 16).

This paper defines the generic limits of *Eutrichites* and provides a supplemental description of *E. zonatus,* including a description of the egg. The following are described as new species: *E. arizonensis* from Arizona; *E. veracruzensis* from Veracruz, Mexico; and *E. buscki* from Panama. *Xybaris funiculis* Park (1942) is transferred to *Eutrichites* and the male described. A key is provided for discriminating species of *Eutrichites* males. Finally, phylogenetic relationships among these species are discussed, and some additional comments are made about the relationship of *Eutrichites* to other genera.

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[1] Published with the approval of the Director, Arkansas Agricultural Experiment Station, Fayetteville, AR.

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DIAGNOSIS OF *EUTRICHITES*

Pselaphid beetles of the tribe Brachyglutini with the following combination of characters: Antennal club composed of a single large terminal antennomere at least as long as preceding four combined (Fig. 2); subocular carinae of head extending from anterior margins of eyes to lateral carinae (Fig. 16); metasternum broadly concave in males (Figs. 4–8); pronotum typically with a median antebasal pit and one pair of lateral antebasal foveae (Fig. 2); each elytron with four antebasal foveae (Fig. 2); mesial aspect of protibia of males bearing a dense mat of pubescence (Fig. 3); profemora of males bearing a dense mat of pubescence (Fig. 3); profemora of males enlarged; tergite VI of each sex strongly deflexed, often with a median tumidity (Fig. 2); one or more sternites of males, beyond II, sexually modified, bearing cusps, lamellae, or pectinate processes (Figs. 11, 12, 14, 18, 19).

Correct identification of *Eutrichites* species is dependent on male sexual characters. Females are usually more common than males and repeated collections from a particular locality may be necessary to obtain males.

KEY TO SPECIES OF MALE *EUTRICHITES*

1. Metasternal margin between metacoxae bearing recurved lamella (or paired lamellae) that bears, along its dorsal aspect, a row of ctenidia (ctenidia visible only in transmitted light); this character may consist of a median pair of simple ctenidia, paired lamellae, or may occupy the entire posterior metasternal margin; sternites bearing pectinate processes or setose cusps 2
– Metasternal margin between metacoxae lacking recurved lamellae or ctenidia (Fig. 8); sternites III and IV bearing prominent spatulate processes along posterior margins (Fig. 19) .... *E. funiculis* (Park)
2. Sternite V bearing pectinate processes along posterior margin; sternite VI lacking cusps 3
– Sternite V lacking pectinate processes; sternite VI bearing paired setose cusps along posterior margin (Figs. 11, 12) 4
3. Metasternal lamellae paired, distantly separated (Fig. 4); sternite V bearing paired lateral and single median pectinate processes (Fig. 14) .... *E. zonatus* (Brendel)
– Metasternal lamella single, represented by median pair of ctenidia (Fig. 5); sternite V bearing only paired pectinate processes that are narrowly separated medially (Fig. 18) .... *E. arizonensis,* new species
4. Metasternal lamella occupying almost entire metasternal margin (Fig. 6) .... *E. veracruzensis,* new species
– Metasternal lamella occupying only median ⅓ of metasternal margin (Fig. 7) .... *E. buscki,* new species

Eutrichites zonatus (Brendel)
(Figs. 1–4, 9, 14–17, 20)

Bythinus zonatus Brendel (1865:28, 29). Lectotype male: "La." Designated by Carl F. Moxey (1962:100), 29 June 1962, Type 8294 (ANSP).

Eutrichites zimmermanni LeConte (1880:184). Lectotype, here designated, male: "Tex." (MCZ). Paralectotypes. Six females, "Tex." (four specimens), "D.C." (one specimen), and "La." (one specimen) [all MCZ].

Eutrichites zonatus: Bowman (1934:78).

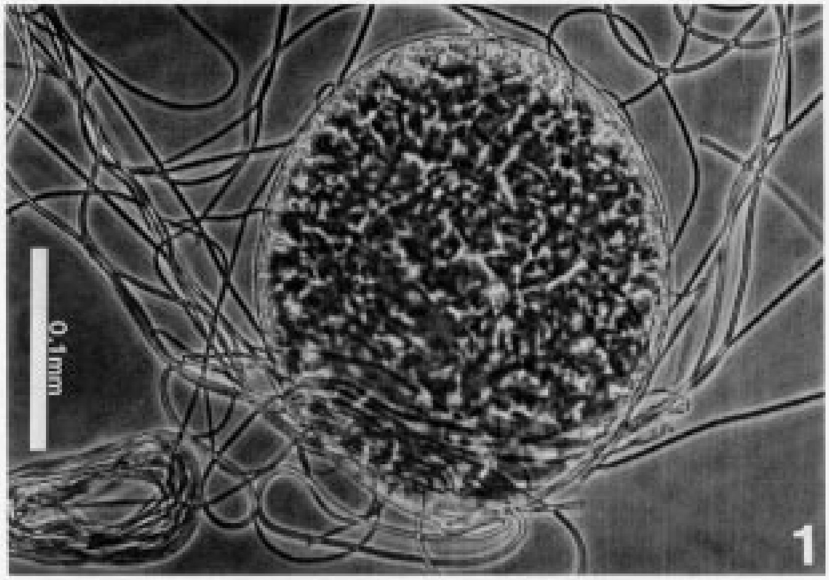


Fig. 1. *Eutrichites zonatus*, egg with associated fibers dissected from preserved female.

EGG (Fig. 1). Dimensions, 0.26 mm × 0.21 mm. Surface slightly irregular, sparsely, minutely tuberculate. Eggs apparently connected at poles by single thin, very long fibers of unknown origin or composition. Excess lengths of fibers lie coiled in oviduct.

COMMENTS. Six eggs were dissected from a single alcohol-preserved female (Illinois, Champaign County, UV light, 14 August 1972). Four eggs were mounted in CMC-acid fuschin medium with associated fibers.

The composition and function of the egg fibers is a mystery. Perhaps the eggs are deposited like a long string of connected beads, or the fibers may form a convoluted attachment to the substrate.

MALE. Measurements (typical). Head 0.35 mm long, 0.33 mm wide; pronotum 0.35 mm long, 0.40 mm wide; elytra 0.60 mm long, 0.62 mm wide; abdomen 0.60 mm long, 0.70 mm wide; antennae 0.75 mm long. Total length, moderately extended, 1.40 mm. Color uniform dark reddish-brown.

Head (Figs. 2, 16). Labrum with median pair of peg-like sensillae. Mandibles with five or six well-developed teeth. Frons with nude median depression. Vertexal foveae nude, connected to frontal depression via shallow interocular sulcus. Antennomere X angulate, broadest at base; XI ovate, as long as preceding five combined.

Pronotum (Fig. 2). Median antebasal pit connected by shallow, narrow antebasal sulcus to each lateral antebasal fovea. Area posterior to antebasal sulcus coarsely punctate.

Wings. Well developed and functional.

Legs. Protibia with dense mat of short pubescence along the mesal aspect (Fig. 3). Profemur enlarged, strongly clavate. Mesocoxae distant.

Mesosternum (Fig. 4). Median mesosternal fovea single, pubescent. Lateral mesosternal foveae pubescent.

Metasternum (Fig. 4). Evenly concave, lacking microsculpture, sparsely pubescent. Longitudinal carina extending from lateral margin of each mesocoxal cavity for ½ distance

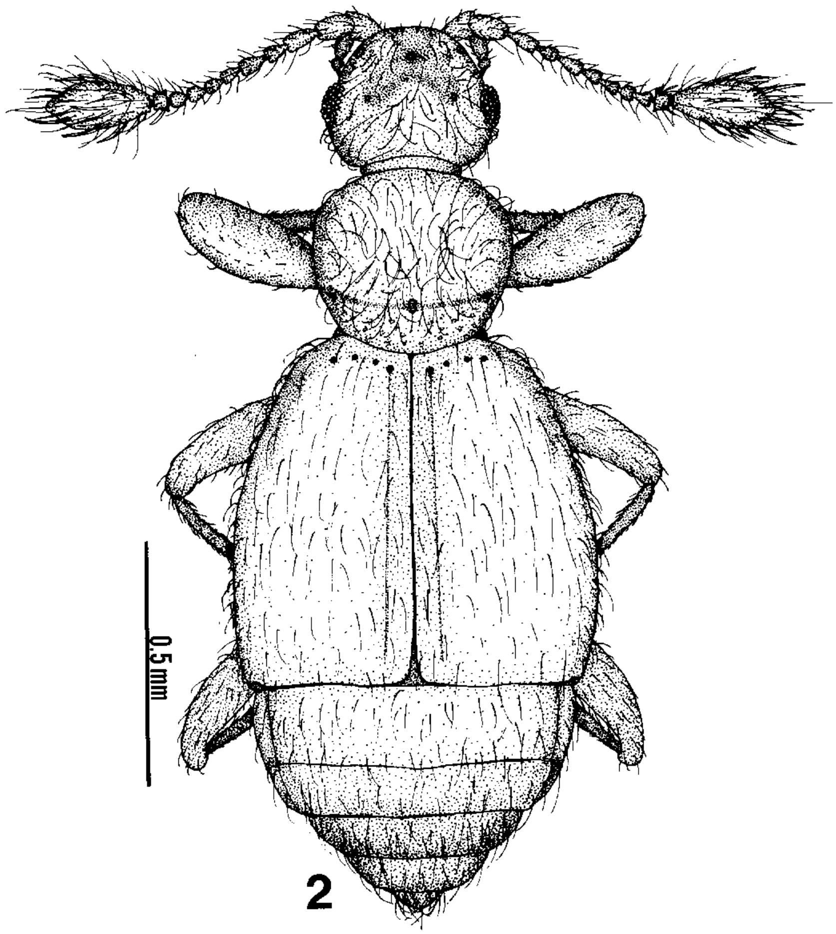


Fig. 2. *Eutrichites zonatus*, dorsal habitus of male.

to posterior metasternal margin. Two small, nude metasternal foveae present posterior to mesocoxae. Posterior margin between metacoxae simple medially, modified laterally into anterior directed lamellae containing seven or eight dorsal ctenidia (see Comments).

Abdomen (Figs. 2, 14). Six tergites and six sternites present externally. Tergite I short, concealed beneath elytra, bearing many rows of minute, oblique lamellae (Fig. 17). Tergite VI strongly deflexed, with a prominent rounded tumidity. Sternites I–IV simple. Sternite V deeply concave medially; concavity bearing, along anterior aspect, pectinate process of approximately 17 recurved ctenidia; posterior margin laterally with oblique pectinate processes of seven or eight ctenidia. Sternite VI with pubescent median depression bordered laterally by tufts of medially directed setae. Sternite VII modified into internal, triangular penial plate that occasionally protrudes from aedeagal orifice.

Aedeagus (Fig. 9). Consisting of broad basal plate articulating with pleural lobes of sternite VI. Ejaculatory duct extending from median lobe of plate to distal articulation, then turning abruptly and coursing posteriorly to lie above basal plate.

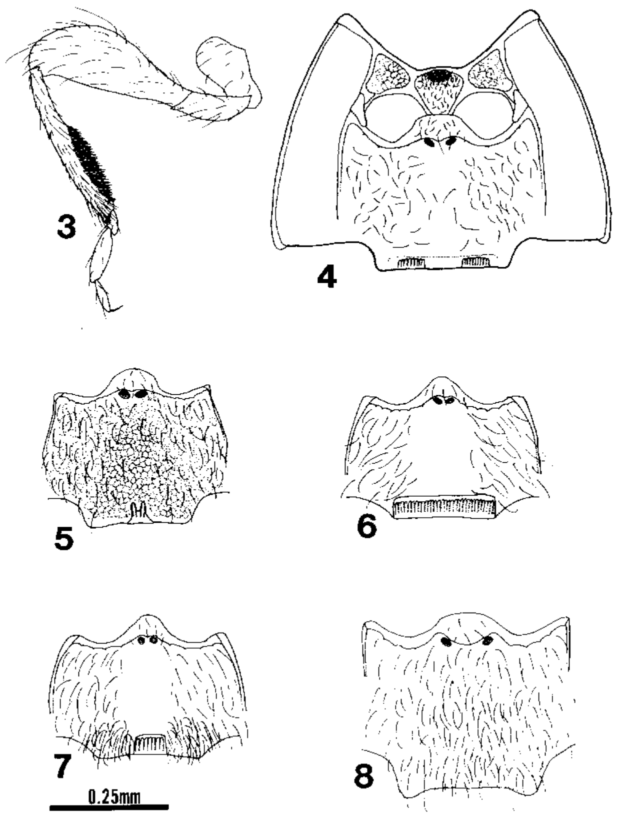
FEMALE. Femora less strongly clavate than in males. Metasternum convex laterally, slightly concave medially, lacking marginal lamellae. Tergite VI with low triangular tumidity. Abdominal sternites (Fig. 15) simple, evenly rounded.

DISTRIBUTION (Fig. 20). Throughout eastern United States and southeastern Canada, from southern Texas and Wisconsin to Georgia and Quebec.

MATERIAL EXAMINED. A total of 582 specimens from 15 states and provinces, in addition to the types, were examined.

CANADA: **Quebec:** Forestville, 23 July 1971, 1 ♂, 5 ♀♀; Montreal, 20 June 1939, 1 ♀; St. Thomas de Joliette, 7 September 1943, 3 ♀♀.

UNITED STATES: **Alabama:** *Butler Co.*, 5 mi. NW Greenville, under bark of pine log, 9 August 1959, 1 ♂; *Lamar Co.*, Kennedy, sawdust pile, 22 September 1963, 3 ♂♂, 7 ♀♀; *Marion Co.*, Bear Creek, under slabs, sawdust pile, 22 June 1960, 1 ♀; *Marshall Co.*, near Griffith Cave, Guntersville, sawdust pile, 2 September 1962, 3 ♂♂, 6 ♀♀; *Talledaga Co.*, McElderry, slash-sawdust pile, 2 September 1959, 12 ♂♂, 13 ♀♀. **Arkansas:** *Madison Co.*, Patrick, 6 July 1932, 1 ♀; *Perry Co.*, Bear Creek at Ark. Highway 7, blacklight, 11 June 1983, 3 ♂♂, 6 ♀♀; *Washington Co.*, Fayetteville, light trap, 10 May 1941, 2 ♂♂, 1 ♀; 1 June 1942, 9 ♂♂, 28 ♀♀. **Georgia:** *Cherokee Co.*, Allatoona Lake, Galts Landing, grassy debris, 23 October 1965, 6 ♀♀; *Rabun Co.*, Dillard, elv. 2,130 ft, sawdust, 31 May 1964, 1 ♀; *Union Co.*, Brasstown Bald, elv. 2,350 ft, 11 August, 8 September 1963, 27 September 1964, 3 ♂♂, 10 ♀♀. **Illinois:** *Champaign Co.*, Nettie Hart Memorial Woods 3.5 mi. NE Mahomet, blacklight along Sangamon River, 20–21 June 1964, 2 ♀♀; 13 June 1964, 1 ♀; 17–18 July 1964, 1 ♂; 7–8 May 1966, 1 ♀; 12–13 June 1966, 1 ♂; 30 June 1966, 1 ♀; 17–18 August 1973, 5 ♀♀; 1 mi. S Mohamet on rt. 47 at Sangamon River, blacklight, 25 July 1973, 1 ♀; 15 August 1973, 5 ♂♂, 10 ♀♀; 26 August 1973, 2 ♀♀; 3 mi. NW Homer, S. Fork Vermillion River, blacklight, 28–29 May 1972, 2 ♂♂, 3 ♀♀; 4–5 June 1972, 5 ♂♂, 9 ♀♀; 26–27 June 1972, 9 ♂♂, 13 ♀♀; 11–12 July 1972, 7 ♀♀; 24–25 July 1972, 5 ♂♂, 21 ♀♀; 2–3 August 1972, 3 ♀♀; 14 August 1972, 1 ♀ (contained 6 eggs); 21–22 August 1972, 1 ♀; 12–13 September 1972, 1 ♀; 31 May 1973, 2 ♀♀; 6 July 1973, 1 ♂; 12 July 1973, 1 ♀; *Jackson Co.*, 3 mi. ESE Grand Tower on Big Muddy River, blacklight, 5 July 1978, 5 ♀♀; *Lake Co.*, 2 mi. N Libertyville on Des Plaines River, blacklight, 7 August 1985, 1 ♂; *McLean Co.*, 4 mi. N Hudson on Mackinaw River, blacklight, 16 ♂♂, 7 ♀♀; *Ogle Co.*, White Pines State Park, Pine Creek, blacklight, 27–28 June 1972, 10 ♂♂, 2 ♀♀; *Piatt Co.*, 4.5 mi. SW Monticello, Allerton Park on Sangamon River, blacklight, 9 July 1973, 1 ♂, 5 ♀♀; 2 August 1973, 9 ♀♀; *Pope Co.*, Bay Creek, Bell Smith Springs Scenic Area, blacklight, 3 June 1985, 2 ♂♂, 18 ♀♀; *Shelby Co.*, Richland Creek 2.5 mi. SE Cowden, blacklight, 1 July 1985, 3 ♂♂, 9 ♀♀; *Union Co.*, Wolf Lake, 28 June 1958, 1 ♀; *Vermillion Co.*, vicinity of Oakwood on Vermillion River and Forks, blacklight, 23 June 1973, 2 ♂♂, 1 ♀; 30 June 1973, 1 ♀; 17 June 1973, 2 ♂♂, 6 ♀♀; 4 July 1973, 2 ♂♂, 13 ♀♀; 10 July 1973, 1 ♀; 30 July 1973, 1 ♂, 4 ♀♀; 8 August 1973, 7 ♀♀; 10 August 1973, 1 ♀; 13 August 1973, 1 ♂, 2 ♀♀; 28 August 1973, 1 ♂, 4 ♀♀; 29 August 1973, 3 ♀♀; *Warren Co.*, Cedar Creek, 3.5 mi. NE Monmouth, blacklight, 21–22 July 1980, 6 ♂♂, 9 ♀♀. **Louisiana:** *Ascension Par.*, Gonzales, huge sawdust pile, 16–17 October 1953, 1 ♀; *Bossier Par.*, Shreveport, 3 June 1949, 1 ♀. **Mississippi:** *Choctaw Co.*, near Chester, Little Mtn. Campground, at light, 24 June 1961, 1 ♀. **North Carolina:** *Davie Co.*, Yadkin River NW of Lexington, blacklight, 22 July 1974, 1 ♀; *Mecklenburg Co.*, Lake Norman near Davidson Creek at Cornelius, light trap, 21 May 1974, 1 ♀; *Montgomery Co.*, Uwharrie River 1.5 mi. NW Uwharrie, blacklight, 23 July 1974, 2 ♂♂, 10



Figs. 3–8. *Eutrichites* spp., males. 3, *E. zonatus,* posterior aspect of left proleg. 4, *E. zonatus,* meso-metasternum. 5–8, metasternum. 5, *E. arizonensis.* 6, *E. veracruzensis.* 7, *E. buscki.* 8, *E. funiculis.*

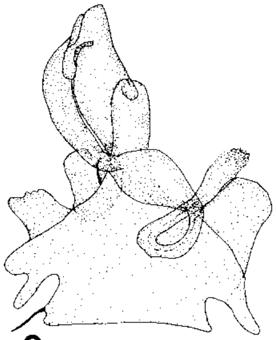
♀♀. **Oklahoma:** *Creek Co.,* Keystone Res. St. Pk., 16 mi. WSW Tulsa, blacklight, 16 June 1977, 2 ♀♀; *Latimer Co.,* wet grassland, December 1982, 2 ♀♀; blacklight, May 1983, 6 ♂♂, 9 ♀♀; June 1983, 2 ♂♂, 4 ♀♀; July 1983, 1 ♀; flood debris, May 1984, 1 ♀; blacklight, September 1984, 1 ♀; flood debris, March 1985, 4 ♀♀; April 1985, 4 ♀♀; blacklight, May 1985, 1 ♀; June 1985, 8 ♂♂, 15 ♀♀; July 1985, 4 ♂♂, 7 ♀♀; flood debris, January 1986, 1 ♀; blacklight, April 1986, 8 ♂♂, 8 ♀♀; blacklight, May 1986, 6 ♂♂, 3 ♀♀; blacklight, June 1986, 4 ♂♂, 5 ♀♀; *Mayes Co.,* Spavinaw, 18 June 1937, 2 ♂♂, 2 ♀♀; Ellerville, 20 June 1937, 1 ♀. **South Carolina:** *Greenwood Co.,* Saluda River below dam, blacklight, 21 Sept. 1974, 1 ♀. **Tennessee:** *Knox Co.,* Knoxville, August 1956, light, 1 ♀; 15 May 1957, 2 ♀♀; *Monroe Co.,* Sweetwater, sawdust pile, 7 May 1955, 2 ♂♂, 1 ♀; *Washington Co.,* sawdust, June 1958, 2 ♀♀. **Texas:** *Cherokee Co.,* Ponta, old sawdust, 7 June 1972, 1 ♀; *Kerr Co.,* N. Fork Guadalupe River, elv. 1,760 ft, blacklight, 23 June 1985, 2 ♂♂, 10 ♀♀; *Llano Co.,* Enchanted Rock, light, 18 April 1959, 2 ♂♂, 6 ♀♀; *Val Verde Co.,* Devil's River 20 mi. N Comstock, elv. 1,500 ft, blacklight, 22 July 1985, 1 ♂,4 ♀♀. **Wisconsin:** *Grant Co.,* 1 July 1952, 1 ♀.

In addition, the following locality records were supplied by Donald S. Chandler: **Alabama:** *Jefferson Co.,* Birmingham, Shades Mountain, light trap, 10 September 1981. **Arkansas:** *Fulton Co.,* 6 mi. W Mammoth Spring, blacklight, 6 June 1970; *Newton Co.,* Buffalo River 12 mi. W Jasper, blacklight, 2 June 1984. **Georgia:** *Clarke Co.,* Whitehall Forest, blacklight, 21–31 August 1978. **Indiana:** *Lawrence Co.,* Spring Mill State Park, 19 June 1983; *Spencer Co.,* Pigeon Creek, 13 June 1983. **Louisiana:** *Evangeline Par.,* Chicot State Park, blacklight, 8 June 1965. **Mississippi:** *Boliver Co.,* 2 mi. W Rosedale, 23 August 1980; *Forrest Co.,* P. B. Johnson State Park, 30 April 1981; *George Co.,* Black Creek, Hwy. 57, 11 May 1981; *Harrison Co.,* Newman Lumber Company, blacklight, 26 May 1969; *Jasper Co.,* 6 mi. NW Montrose, 7 May 1980; *Lafayette Co.,* Oxford, 16 July 1979; *Lamar Co.,* 5 mi. N Baxterville, 9 April 1981; *Newton Co.,* 6 mi. SE Newton, 10 May 1979; *Oktibbeha Co.,* Starkville, blacklight, 4 May 1982; *Pearl River Co.,* 1 mi. SW Silver Run, 26 May 1980; *Stone Co.,* Red Creek at Hwy. 15, 3 June 1981; *Tishomingo Co.,* Tishomingo State Park, 9 June 1984; *Warren Co.,* 8 mi. NE Bovina, 24 June 1981. **New Hampshire:** *Stafford Co.,* 3 mi. SE Dover, blacklight, 28 June 1984. **North Carolina:** *Henderson Co.,* Fletcher, 18 June 1971. **Oklahoma:** *Latimer Co.,* December 1982, May 1983. **Texas:** *Bastrop Co.,* Bastrop State Park, blacklight, 26 May 1983; *Brazos Co.,* 1.5 mi. W Bryan, 11–20 June 1981; *Real Co.,* 6 mi. SE Leakey, blacklight, 1 July 1971; *San Jacinto Co.,* 3 mi. E Cold Springs, Double Lake Campground, 22–24 May 1983. **Wisconsin:** *Grant Co.,* Boscobel, light, 3 July 1953.

COMMENTS. During 10 years of collecting berlese samples from a variety of woodland habitats throughout Arkansas I have not recovered a single specimen of *E. zonatus.* Elsewhere most of the specimens examined were taken at blacklight traps near streams. A significant number were collected from sawdust heaps, but this is an artificial habitat. The species has been consistently taken in flood debris by Karl Stephan, and this may be the preferred habitat. In a series of 59 UV light samples taken in Illinois by The Illinois Natural History Survey the sex ratio was 2.7:1 (n = 191:71) in favor of females. Specimens were collected during every month from May through September.

The minute lamellae that occur on tergite I (Fig. 17) are clearly visible only on scanning electron micrographs. They also occur along the posteroventral margins of the elytra. Similar structures, in the form of minute ctenidia, occur on tergite I of the euplectine pselaphid, *Conoplectus canaliculatus* (LeConte) and other species. In winged pselaphids these structures may assist in folding the wings. The wings are provided with microsetae that may mesh with these processes during folding. Slight alternating lateral movements of the abdomen and elytra may serve to fold the wings and tuck them beneath the elytra. Confirmation must await direct observation of wing folding behavior, which has proven difficult to elicit under artificial circumstances. Most winged staphylinids employ the entire abdomen during wing folding in a rather complex set of movements during which the wings seem to vanish beneath the upheld elytra. Winged pselaphids must accomplish the same end with much less freedom of movement.

The ctenidial structures of the metasternal lamellae of males of this species and the three that follow are difficult to observe except by transmitted light through slide-mounted specimens. The ctenidia are fully differentiated only along the dorsal aspect of the thin anteriorly directed lamellae. The ventral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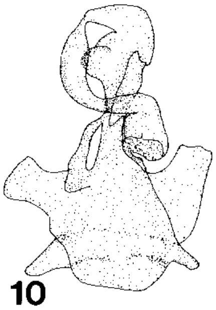
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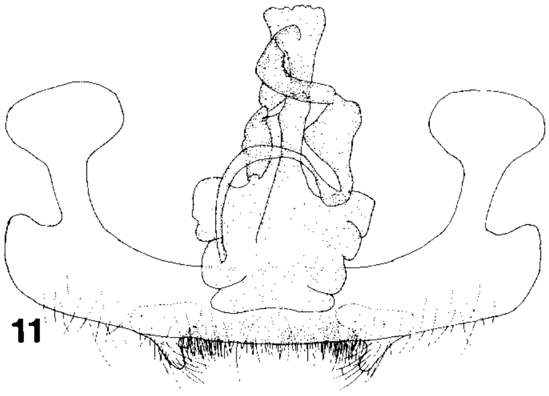
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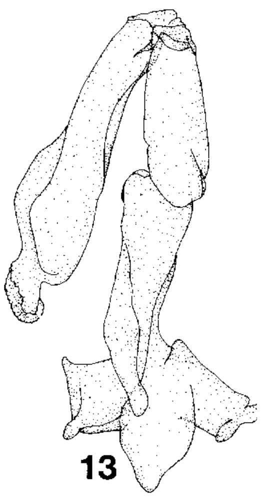
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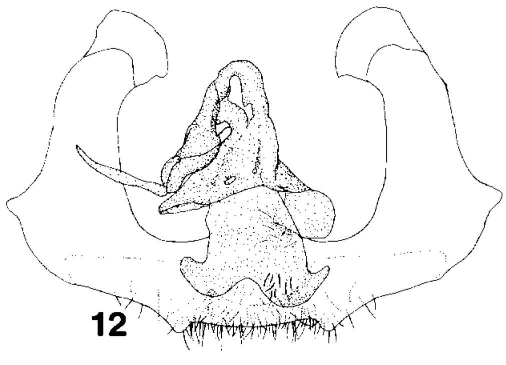
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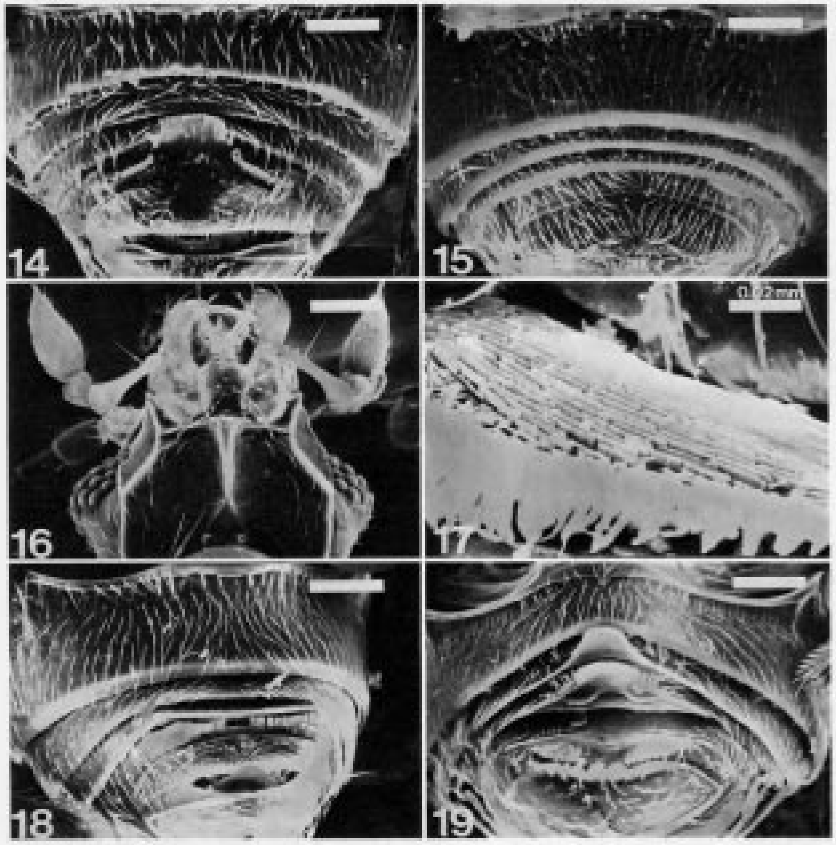
Figs. 9–13. *Eutrichites* spp., aedeagi and sixth sternites. 9, *E. zonatus.* 10, *E. ar* *zonensis.* 11, *E. veracruzensis.* 12, *E. buscki.* 13, *E. funiculis.*



Figs. 14–17. *Eutrichites zonatus.* 14, ventral aspect of male abdomen. 15, ventral aspect of female abdomen. 16, ventral aspect of head. 17, oblique lamellae of tergite I.

Figs. 18, 19. *Eutrichites* spp., ventral aspect of male abdomen. 18, *E. arizonensis.* 19, *E. funiculis.* Scale bars equal 0.1 mm unless otherwise indicated.

aspects of the lamellae are complete and appear simple and flat in dry mounts and scanning electron micrographs.

The type series of *E. zimmermanni* was originally labeled "Eutrichius dixianus" by Zimmermann. LeConte (1880) mentioned that name, but did not use it, choosing instead to name the species after Zimmermann.

Eutrichites arizonensis Carlton, **new species**
(Figs. 5, 10, 18, 20)

TYPE MATERIAL. Holotype male: **Arizona:** Yavapai County, Verde River, Cottonwood, 19–27 July 1981, UV light trap, M. W. Sanderson, deposited at FMNH.

Paratypes: 26 ♂♂, 26 ♀♀, same data as holotype, deposited as follows: nine

♂♂, nine ♀♀, FMNH; five ♂♂, five ♀♀, USNM; two ♂♂, two ♀♀ each, DSC, UAIC, UCD, AMNH, MCZ and ANSP.

MALE. Measurements (typical). Head 0.30 mm long, 0.30 mm wide; pronotum 0.30 mm long, 0.33 mm wide; elytra 0.50 mm long, 0.55 mm wide; abdomen 0.45 mm long, 0.50 mm wide; antennae 0.60 mm long; total length, moderately extended, 1.20 mm. Color uniform yellowish-brown.

Head. Interocular sulcus obsolete, differentiated only as a shallow interantennal depression.

Pronotum. Antebasal sulcus indistinct, obscured by coarse basal punctation.

Metasternum (Fig. 5). Evenly concave with coarse, reticulate microsculpture and sparse pubescence. Posterior margin between metacoxae simple laterally, bearing single median pair of anteriorly directed ctenidia which constitute the metasternal lamella.

Abdomen (Fig. 18). Tergite VI with only slight median tumidity. Sternites I–III simple. Sternite IV medially flattened. Sternite V slightly concave, bearing along posterior margin paired pectinate processes of approximately 20 recurved ctenidia each, these processes narrowly separated medially. Sternite VI flat to slightly convex, unmodified.

Aedeagus (Fig. 10) differing from that of *E. zonatus* in only minor details.

FEMALE. Metasternum convex laterally, slightly concave medially, lacking marginal ctenidia. Tergite VI almost evenly rounded, median tumidity scarcely apparent.

Other characters of the species as described for *E. zonatus.*

DISTRIBUTION (Fig. 20). Known only from intermediate elevations (3,000–7,000 ft) in Arizona, from the vicinity of Flagstaff to the Mexican border. A single female from Sonora, Mexico is tentatively assigned to this species.

MATERIAL EXAMINED. Holotype, paratypes, and 310 additional specimens (not considered as paratypes) were examined.

MEXICO: **Sonora:** 5 mi. E Alamos, blacklight, 11 August 1973, 1 ♀.

UNITED STATES: **Arizona:** *Coconino Co.,* Oak Creek, Chaves Crossing, blacklight, 20 July 1977, 5 ♀♀; 26 August 1978, 4 ♀♀; Oak Creek at Bootlegger Campground, blacklight, 14 August 1977, 1 ♀; Oak Creek at Pine Flat Campground, blacklight, 1 ♀; Oak Creek, Indian Gardens, blacklight, 21 June 1978, 1 ♀; 29 July 1977, 1 ♂, 3 ♀♀; Sedona, blacklight, 24 July 1977, 1 ♂, 4 ♀♀; 29 August 1977, 1 ♂, 3 ♀♀; 22 May 1978, 1 ♀; Oak Creek at Grasshopper Point, blacklight, 12 July 1977, 2 ♀♀; 19 June 1978, 2 ♀♀; Oak Creek at Encinoso Picnic Ground, blacklight, 3 August 1977, 1 ♀; Village Oak Creek S Sedona, porch light, 13–15 August 1982, 3 ♀♀, 1 ♂; Oak Creek at West Fork, blacklight, 19 July 1979, 1 ♀; *Graham Co.,* Aravaipa Canyon, elv. 3,050 ft, 24 August 1976, 7 ♂♂, 6 ♀♀; *Pima Co.,* Santa Catalina Mts., Molino Canyon, 8 August 1969, 2 ♀♀; Sabino Canyon, 25 July 1966, 1 ♂; Tucson Mtn. Park, Palo Verde Campground, blacklight, 31 August 1970, 1 ♂; *Pinal Co.,* Superior, at light, August–September 1949, 1 ♀; Boyce Thompson Arboretum, light, 12–24 September 1949, 4 ♂♂, 3 ♀♀; *Santa Cruz Co.,* Patagonia, 21 August 1940, 4 ♀♀; *Yavapai Co.,* Oak Creek at Page Springs, blacklight, 14 July 1977, 2 ♀♀; 11 August 1978, 2 ♂♂, 2 ♀♀; Red Tank Draw at Soda Springs Ranch, blacklight, 18–19 May 1984, 1 ♀; Road 120 S Village Oak Creek, blacklight, 3–4 August 1983, 1 ♀; Oak Creek at Cornville, blacklight, 8 August 1978, 3 ♂♂, 4 ♀♀; Beaver Creek below Montezuma's Well, blacklight, 29–30 August 1985, 2 ♂♂, 2 ♀♀; Verde River, Cottonwood, blacklight, 19–27 July 1981, 52 ♂♂, 90 ♀♀; Village Oak Creek, blacklight, 2–5 August 1982, 1 ♀; 14 August 1983, 1 ♂, 2 ♀♀; West Clear Creek Road NE Camp Verde, blacklight, 28 June 1980, 1 ♀; Sycamore Creek SE Camp Verde, blacklight, 6–7 June 1981, 1 ♀; Oak Creek, Deer Pass, blacklight, 15–16 July 1977, 8 ♀♀; Confluence of Oak Creek and Verde River, blacklight, 9–10 June 1977, 14 ♂♂, 12 ♀♀; Oak Creek at Red Rock Crossing, blacklight, 9 June 1977, 1 ♀; Oak Creek at Baldwin's Crossing, blacklight, 19 July 1977, 10 ♀♀; Beaver Creek E Jct. 17/179, blacklight, 9–10 May 1984, 1 ♀; 14–15 May 1984, 2 ♀♀; Camp Verde, blacklight, 10 July 1980, 6 ♂♂, 50 ♀♀; 13–14 June 1981, 1 ♂, 6 ♀♀; Hassayampa River S Prescott, blacklight, 18–19 June 1985, 1 ♀.

COMMENTS. The majority of specimens examined were collected at blacklight traps operated by Dr. Milton Sanderson in Coconino and Yavapai counties, near Sedona, Arizona. The sex ratio from 37 of these samples was 3.2:1 (n = 237:73) in favor of females. All specimens were collected during the months of May through September, but 97% were taken during June, July, and August.

Eutrichites veracruzensis Carlton, **new species**
(Figs. 6, 11, 20)

TYPE MATERIAL. Holotype male: MEXICO: **Veracruz:** Puente Nacional, 6 mi. SE of Rinconada, 29 September 1975, at light, J. Powell and J. Chemsak, deposited at FMNH.

Paratypes: One ♂, two ♀♀, same data as holotype, deposited as follows: one ♀, FMNH; one ♂, one ♀, DSC.

MALE. Measurements (holotype). Head 0.30 mm long, 0.30 mm wide; pronotum 0.38 mm long, 0.35 mm wide; elytra 0.45 mm long, 0.55 mm wide; abdomen 0.40 mm long, 0.45 mm wide; antennae 0.55 mm long; total length, moderately extended, 1.20 mm. Color uniform reddish-brown.

Head. Interocular sulcus obsolete, differentiated only as a shallow interantennal depression.

Pronotum. Antebasal sulcus indistinct, obscured by basal punctation.

Metasternum (Fig. 6). Evenly concave, sparsely pubescent laterally, lacking microsculpture. Longitudinal carinae extending ¾ distance to posterior metasternal margin. Entire posterior margin between metacoxae consisting of an anteriorly directed lamella with 28–30 dorsal ctenidia.

Abdomen. Tergite VI with only a slight median tumidity. Sternites I–V simple, convex. Sternite VI (Fig. 11) slightly concave medially, posterior margin bearing a pair of medially directed digitate processes that bear tufts of setae.

Aedeagus (Fig. 11). Basal plate broad and lobate. Recurved ejaculatory duct long and sinuate.

FEMALE. Metasternum convex laterally, flattened medially, lacking marginal lamella. Tergite VI almost evenly rounded, median tumidity scarcely apparent.

Other characters of the species as described for *E. zonatus.*

DISTRIBUTION (Fig. 20). Known only from the type locality.

MATERIAL EXAMINED. Holotype and paratypes (see Type Material).

COMMENTS. Sternite VI of *E. veracruzensis* resembles that of *E. buscki,* though the lateral processes of the former are more prominent. The broad continuous metasternal lamella represents the maximum development of that character within the genus.

Eutrichites buscki Carlton, **new species**
(Figs. 7, 12, 20)

TYPE MATERIAL. Holotype male: **Panama:** Trinidad Rio, 9 June 1912, A. Busck, deposited at FMNH.

Paratypes: Five ♂♂, four ♀♀, same data as holotype, deposited as follows: one ♀, FMNH; five ♂♂, three ♀♀, USNM.

ETYMOLOGY. Patronymic after the collector of the type series, August Busck.

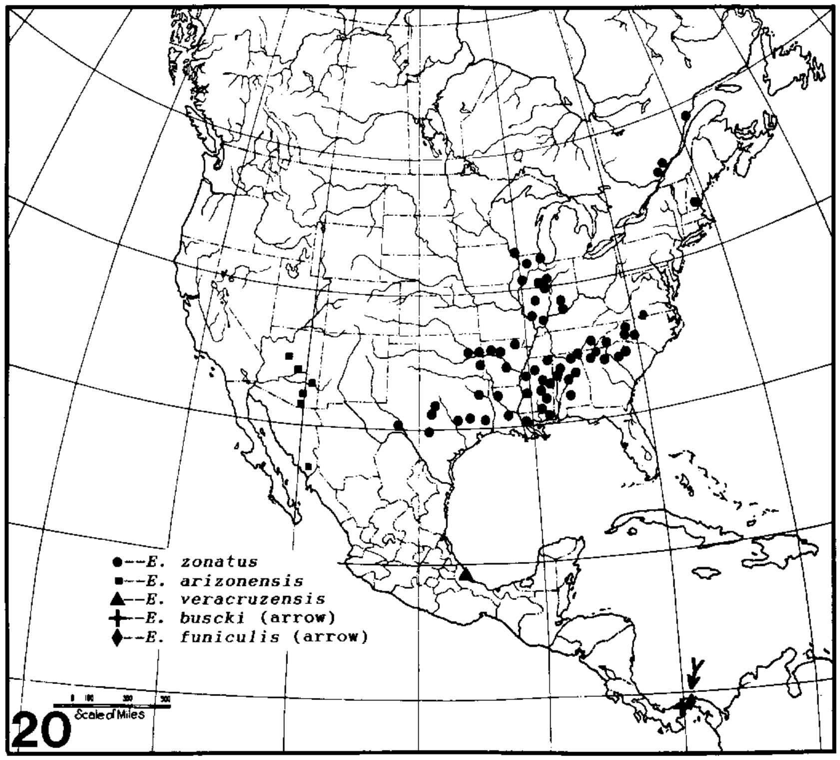


Fig. 20. North and Middle American collecting localities of *Eutrichites* spp.

MALE. Measurements (holotype). Head 0.35 mm long, 0.30 mm wide; pronotum 0.35 mm long, 0.35 mm wide; elytra 0.45 mm long, 0.60 mm wide; abdomen 0.50 mm long, 0.58 mm wide; antennae 0.55 mm long; total length, moderately extended, 1.25 mm. Color uniform reddish-brown.

Head. Interocular sulcus shallow but well-defined.

Pronotum. Antebasal sulcus indistinct, obscured by basal punctation.

Metasternum (Fig. 7). Evenly concave, sparsely pubescent, lacking microsculpture. Median ⅓ of posterior margin between metacoxae consisting of anteriorly directed lamella with approximately 12 dorsal ctenidia.

Abdomen. Tergite VI with prominent median tumidity which is pubescent apically. Sternites I–IV simple, convex. Sternites V–VI medially flattened. Posterior margin of sternite VI (Fig. 12) bearing pair of low setose cusps laterally, densely pubescent medially.

Aedeagus (Fig. 12). Basal plate broadly bifurcate distally. Recurved ejaculatory duct long and sinuate, as in *E. veracruzensis*.

FEMALE. Metasternum convex laterally, weakly concave medially, lacking marginal lamella. Tergite VI distinctly concave medially, bearing low tumidity anterior to concavity.

Other characters of the species as described for *E. zonatus*.

DISTRIBUTION (Fig. 20). Known only from the type locality.

MATERIAL EXAMINED. Holotype and paratypes (see Type Material).

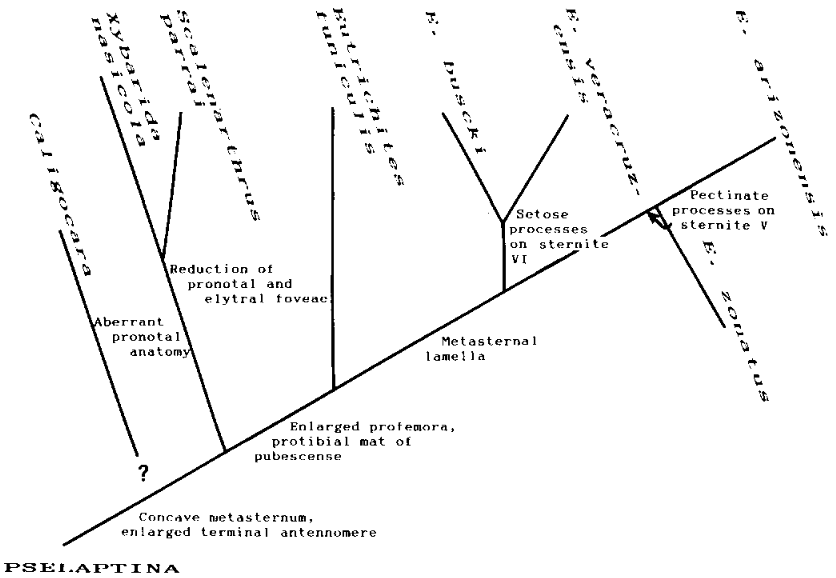


Fig. 21. Cladogram of *Eutrichites* spp. and related taxa.

COMMENTS. This species is known only from the type series, which was collected on a single date in 1912. Additional specimens may be found in unsorted lots of Central American brachyglutines. This species and *E. funiculis* are probably sympatric. Males may be easily separated by differences in metasternal and abdominal morphology (see key), but females of the two species are very similar. In the absence of males, the slightly deeper concavity of tergite VI and greater development of the median tumidity separate *E. funiculis* from *E. buscki.*

Eutrichites funiculis (Park), **new combination**
(Figs. 8, 13, 19, 20)

Xybaris funiculis (Park 1942:177). Holotype female: **Panama Canal Zone:** Gatun Lake, Barro Colorado Island, at light, 7 or 17 July 1936, O. Park (FMNH).

MALE. Measurements (typical). Head 0.30 mm long, 0.30 mm wide; pronotum 0.30 mm long, 0.35 mm wide; elytra 0.50 mm long, 0.55 mm wide; abdomen 0.45 mm long, 0.50 mm wide; antennae 0.55 mm long; total length (moderately extended) 1.30 mm. Color dark reddish-brown.

Head. Interocular sulcus shallow but well-defined.

Pronotum. Antebasal sulcus obscured by basal punctation.

Legs. Protibia enlarged, only slightly narrower than profemur. Mesotrochanter with weak ventral tooth.

Metasternum (Fig. 8). Evenly concave, concavity moderately pubescent, lacking marginal lamella.

Abdomen (Fig. 19). Tergite VI evenly rounded, pubescent along apex. Sternites I–II simple. Posterior margin of sternite III bearing a median, recurved, spoon-shaped process. Posterior margin of sternite IV with similar though broader process. Sternites V–VI deeply concave and naked.

Aedeagus (Fig. 13). Basal plate consisting of a spatulate median portion partially enveloped by quadrate lateral portions. Ejaculatory duct very long and relatively broad, occupying almost entire length of abdomen.

FEMALE. For a complete description of the female see Park (1942).

DISTRIBUTION (Fig. 20). Panama Canal Zone and western Venezuela, the latter represented by a single male specimen (UCD).

MATERIAL EXAMINED. Female syntype and 25 additional specimens as follows: **Panama Canal Zone:** Balboa, 0825 Plank St., 18 July 1946, 1 ♂; Madden Dam, 29 June 1946, 2 ♂♂, 1 ♀; Penitentiary, 12 January 1946, 1 ♂; "#5," 15 May 1946, 4 ♂♂, 2 ♀♀; Fort Kobbe, blacklight, 9 June 1976, 2 ♂♂, 1 ♀; 5.5 mi. NW Gamboa, 4–8 August 1975, 2 ♂♂, 6 ♀♀; Barro Colorado Island, 18 June 1980, 1 ♂. **Venezuela:** Barrancas, Obispos Barinas, 6 July 1979, 1 ♂.

COMMENTS. I am not familiar with the other members of *Xybaris,* which are all South American. Park's placement of this species, which he described from females, was based on nine character states which occur in various combinations throughout this group of genera and which are almost certainly plesiomorphic with regard to this species. Sexual modifications present in males, especially the enlarged profemora and tibial mat of pubescence, place the species clearly within *Eutrichites.*

PHYLOGENETIC RELATIONSHIPS

Eutrichites, as here defined, presents a progressive series of apomorphic character states, making construction of a reasonably parsimonious cladogram possible. The phylogeny (Fig. 21) here proposed was derived by out-group analysis of various species from the following genera: *Scalenarthrus, Cryphorhinula, Caligocara, Pselaptus,* and *Xybarida.* Of particular interest are species within these genera which possess concave metasterna (opposed to convex metasterna) in males. I regard this character state as a significant synapomorphy defining the lineage ultimately leading to *Eutrichites.* An antennal club consisting of a large terminal antennomere (opposed to club consisting of a number of antennomeres of gradually increasing widths) represents a further synapomorphy within the lineage. Two species, *Scalenarthrus parrai* Park and *Xybarida nasicola* Park, fall just beyond the generic limits of *Eutrichites.* Both possess slightly concave metasterna, enlarged terminal antennomeres and low cusps on one of the male sternites (VI of *S. parrai,* V of *X. nasicola*). Neither species possesses the dense protibial mat of pubescence which occurs on all males of *Eutrichites.* The presence of cusps on the abdominal sternites is suggestive of *E. veracruzensis* and *E. buscki,* but the sequence of other character states indicates that this similarity is the result of convergence. The reduction in pronotal and elytral foveae in *S. parrai* and *X. nasicola* supports placement of these species in a monophyletic lineage diverging near the base of the *Eutrichites* lineage. *Caligocara* species also possess concave male metasterna, enlarged terminal antennomeres, and modified sternites, which are suggestive of *Eutrichites,* but the pronotum is aberrant and unlike anything seen in this group of genera. *Caligocara* may represent an aberrant offshoot near *Eutrichites.*

Thus, *Eutrichites* represents one extremity in a progression of pselaptine forms. Synapomorphies which define the cutoff between *Eutrichites* and other genera are the protibial mat of pubescence and enlarged profemora of the males. The first synapomorphic character state to appear within *Eutrichites* is the metasternal lamella, which occurs in all species except *E. funiculis. Eutrichites buscki* and *E. veracruzensis* represent a lineage defined by the setose cusps or processes of sternite VI. Finally, *E. arizonensis* and *E. zonatus* are close sister species linked by the pectinate processes of sternite V.

Park (1945:400) recognized the taxonomic dilemmas posed by genera now placed in the Pselaptina. The limits between these genera are unclear and attempts to resolve them into monophyletic units are likely to result in a wholesale rearrangement of at least *Scalenarthrus* and *Pselaptus,* which appear to be polyphyletic assemblages. It is essential that genera be defined and limited by one or more consistent synapomorphic characters. Only then will judicious reassignment of species clarify the phylogenetic relationships within lineages represented.

ACKNOWLEDGMENTS

I thank the following individuals and institutions for supplying loans which aided this study: Steve Ashe, John Wagner, and Alfred Newton (FMNH); Donald Chandler (UNH); Lee Herman (AMNH); Charles Vogt (MCZ); Donald Azuma (ANSP); Robert Schuster (UCD); and Milton Sanderson.

I am particularly indebted to Drs. Chandler and Sanderson for their helpful comments and free exchange of ideas. For their assistance in technical matters and manuscript reviews I thank William Yearian, Mike Mathis, Richard Leschen, Robert T. Allen, and Jacob R. Phillips.

ABBREVIATIONS

AMNH—American Museum of Natural History, New York, New York;
ANSP—Academy of Natural Sciences, Philadelphia, Pennsylvania;
DSC—Donald S. Chandler Collection, Durham, New Hampshire;
FMNH—Field Museum of Natural History, Chicago, Illinois;
MCZ—Museum of Comparative Zoology, Cambridge, Massachusetts;
UAIC—University of Arkansas Insect Collection, Fayetteville, Arkansas;
UCD—University of California, Davis, California;
UNH—University of New Hampshire, Durham, New Hampshire.

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(Received 16 May 1988; revised 8 November 1988; accepted 15 November 1988)

BOOK REVIEW

WOOD, STEPHEN L., AND DONALD E. BRIGHT, JR. 1987. **A Catalog of Scolytidae and Platypodidae (Coleoptera), Part 1: Bibliography.** Great Basin Naturalist Memoirs No. 11. Brigham Young University, 685 pp. Soft covers US $30.00.

The present volume of the Great Basin Naturalist Memoirs deals with two beetle families, which are not only of interest for systematic, but also for applied entomology. That is why the number of references about bark and ambrosia beetles is so high. It is impossible to work successful in these groups without the knowledge of the hitherto published literature. In the present bibliography are represented 21,488 references to published articles that treat the scientific study of Scolytidae and Platypodidae worldwide from 1758 to 1984 (about 200 post-1984 articles are included). Each reference is accompanied by an indication of the subject areas treated by the article. There are 8 subject areas: Anatomy, Behaviour, Control, Ecology, Habits, Distribution, Taxonomy, and Miscellaneous.

The authors indicated by a plus sign (+) those articles that they were unable to examine. The main part of these articles where published in European journals (mostly forestry journals) or entomological works of the two last centuries. It seems that the authors have not contacted some of the special libraries in Europe to verify these articles. The reviewer checked a sample some of them and found that they are housed in the Bibliothek des Instituts für Forstwissenschaften Eberswalde and/or in the Entomologische Bibliothek des Bereichs Eberswalde des Instituts für Pflanzenschutzforschung Kleinmachnow. The stock of these libraries (concerning the older literature) is indicated in catalogs: Katalog der Bibliothek des Deutschen Entomologischen Museums [now: Inst. Pflanzenschutzforschung Kleinmachnow, Bereich Eberswalde] Teil I. Einzelwerke und Separata. Berlin-Dahlem, 313 pp., 1913. Katalog der Bibliothek der Königlichen Forstakademie Eberswalde [now: Inst. Forst-wissenschaften], 726 pp., 1885. Nachtrag 1885–1899, 410 pp. It would be useful to check these and other catalogs of other European specialized libraries or the stocks of them to get some more completion in checked articles.

It was originally intended that this catalog would be compiled in two parts and published as one unit: (1) the subject index and (2) the bibliography. Due to the enormity of the project the authors have elected to complete the bibliography first. The subject index is well underway and will follow in due course of time. It is to hope, that this second part is to be published as soon as possible.

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LITERATURE NOTICES

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The Coleopterists Bulletin, 43(2):121–126. 1989.

A NEW GENUS AND TWO SPECIES OF ANT-ASSOCIATED HISTERIDS FROM PANAMA (COLEOPTERA: HISTERIDAE: HETAERIINAE)

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ABSTRACT

The genus *Voratister* and its two included species *V. panamensis* and *V. gilli* are described as new. The placement of this genus within the Hetaeriinae and the usefulness of flight interception traps for collecting members of this subfamily are discussed.

All known members of the subfamily Hetaeriinae are associated with either ants, predominantly army ants, or termites. Helava *et al.* (1985) presented a scheme for the higher classification of this subfamily. This paper is the first in a planned series in which each of the genera belonging to the Hetaeriinae will be revised. The material for these new taxa was collected by Dr. Bruce Gill in Panama, using flight interception traps, in this case a Malaise trap with a collecting trough beneath its central panel (Peck and Davies 1980; Masner and Goulet 1981). Of the histerids recovered from these traps, approximately 1% belong in the Hetaeriinae. Akre (1968) first suggested the possibility that the reproductive cycles of histerids associated with army ants are synchronized with the nomadic-statary phases of the ants. Studies of *Euxenister caroli* Reichensperger and *E. wheeleri* Mann (Torgerson and Akre 1970) tend to confirm this hypothesis, but indicate that although oviposition occurs at the beginning of a statary phase, the new generation of these two species is unable to complete its cycle in time to move with the ants at the beginning of the next nomadic phase. Many histerids associated with army ants probably share this inability, and newly emerging adults find host colonies by odor and fly to them. Undoubtedly, it is during these searching flights that these histerids are caught in flight interception traps.

Voratister Helava, **new genus**

Figs. 1–6

TYPE-SPECIES. *Voratister panamensis*, new species.

DESCRIPTION. Form oval (Fig. 1); not setose above. Head 1.4 times as wide as long; lateral margins carinate from occiput to front margin of clypeus, these carinae strongly elevated and widely separated in front; vertex and frons not broadened; mandibles with outer surface unmodified near base; labrum twice as wide as long, apical margin truncate, apical surface broad; antennal club oval, sclerotized on dorsal, ventral and inner surfaces. Pronotum (Fig. 1) 1.8 times as wide as long; lateral margins feebly arcuate, convergent forward; front angles obliquely truncate; surface evenly convex; with median, oval to tear-shaped punctures that are smaller at sides and larger at middle; with one lateral stria parallel to and approximate to marginal stria; hind margin arcuate; hypomeron without setose patches. Elytron (Figs. 1, 3) evenly convex; dorsal striae marked by large crescentiform punctures; internal subhumeral stria long, feebly sinuate; external subhumeral stria long, strongly sinuate. Propygidium 1.7 times as wide as long; surface broadly, transversely inflated behind. Pygidium as wide as long; surface convex. Prosternum (Fig. 2) with keel somewhat narrow, convex; carinal striae cariniform, joined in narrow arch in front; lateral striae evanescent; lateral marginal striae cariniform, divergent foward; lobe separated from rest of prosternum by suture, with marginal stria narrowly separated from lateral margins, preapical stria present; hind margin broadly, deeply, triangularly emarginate. Mesosternum produced forward to fit prosternal emargination; marginal stria present; without lateral foveae. Metasternum (Figs. 2, 4) with striae marked by round punctures; with postcoxal stria present; outer lateral stria short, arcuate, its front end close to midline and parallel to midline and inner lateral stria, its hind end nearly joined to postcoxal stria; inner lateral stria strongly sinuate, its front end close to midline, thence transversely arcuate, nearly reaching to hind coxa. First abdominal sternum (Fig. 4) with two postcoxal striae. Legs (Fig. 2) normal length; tibiae expanded; front tibia with outer edge arcuate; middle and hind tibiae with outer edges broadly angulate. Male genitalia (including terminalia) as in Figures 5, 6; 8th tergite without transverse apical stria, without inward extensions along ventral hind margin; 8th sternites separate, with "disks," without setae along apical margin; 9th tergites with ventral "apodemes," without internal "guides" for aedeagus, apical margin produced forward to form "hooked" structures; 10th tergite absent; basal piece long, parameres very short.

ETYMOLOGY. "Vorator" meaning devourer and the suffix "-ister" meaning "having the nature of." The name is masculine.

REMARKS. The genus *Voratister* may be separated from all other genera in this subfamily by the arrangement of the lateral metasternal striae (Figs. 2, 4). The outer lateral stria is short and arcuate; its front end is close to the midline and parallel to both the midline and the inner lateral stria, and its hind end is nearly joined to the postcoxal stria. The inner lateral stria is strongly sinuate; its front end is close to and parallel to the midline thence transversely arcuate and nearly reaching to hind coxa. The characters of the male genitalia indicate that this genus should be placed near *Paratropinus* Reichensperger and *Nymphister* Reichensperger.

In the generic key published by Helava *et al.* (1985), *Voratister* runs to couplet 70 which separates the genera *Daitrosister* Helava and *Paratropinus*. The distinctive conformation of the lateral metasternal striae will readily separate *Voratister* from them.

KEY TO THE SPECIES OF *VORATISTER*

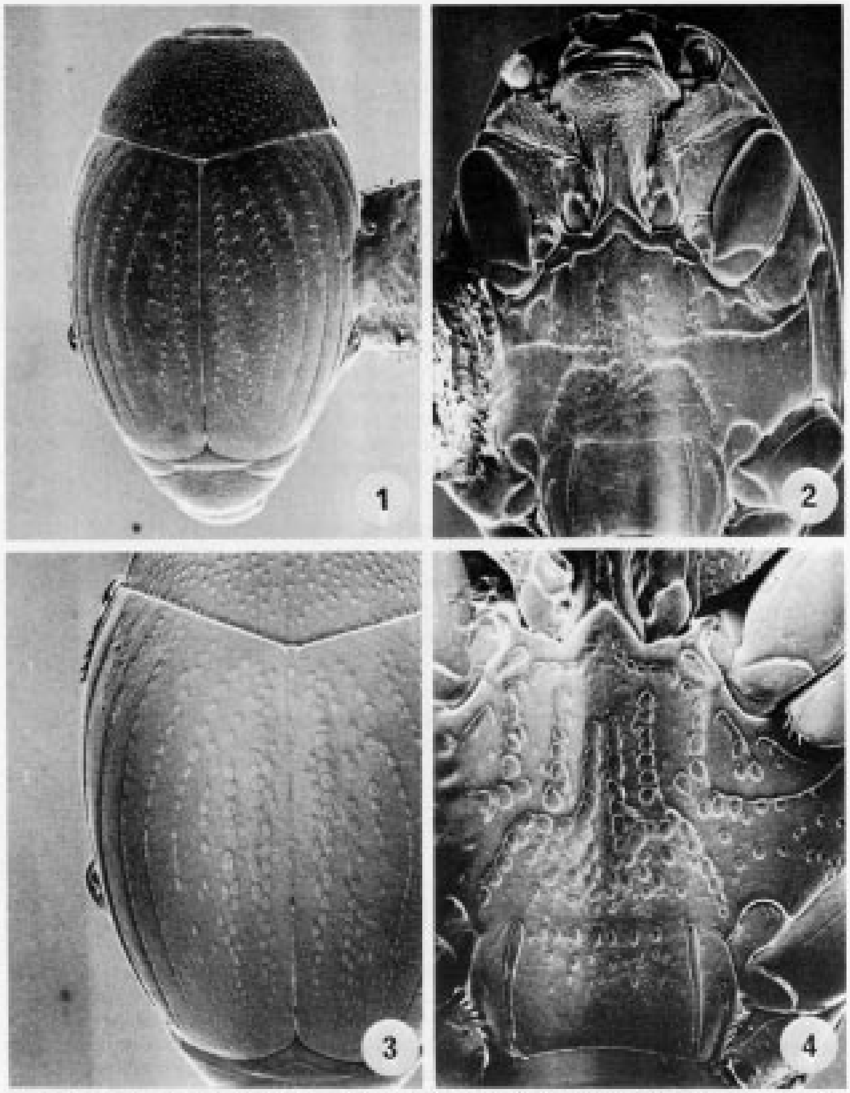
1. Metasternal disk without large punctures, except those marking striae (Fig. 2); elytra without dorsal stria five (Fig. 1) .... *V. panamensis*, new species
– Metasternal disk with large punctures between inner lateral striae (Fig. 4); elytra with dorsal stria five present, although somewhat indistinct (Fig. 3) .... *V. gilli*, new species

Voratister panamensis Helava, **new species**

Figs. 1, 2, 5

TYPES. Holotype, male, PANAMA, Gatun Lake, Barro Colorado Is., 20–28 May 1981, B. Gill, Trap: flight intercept (National Museum of Natural Sciences, Ottawa). Allotype, female, same data as holotype except 5–7 May 1981 (National Museum of Natural Sciences, Ottawa). Host: no data.

DESCRIPTION. Length: 2.00–2.11 mm; width: 1.50–1.62 mm. Head with vertex flat, sparsely punctate, these punctures elongate oval to irregular; frons and clypeus minutely



Figs. 1–4. *Voratister* spp. 1, dorsal view of *V. panamensis* (holotype). 2, ventral view of *V. panamensis* (holotype). 3, left elytron of *V. gilli* (holotype). 4, meso- and metasternum of *V. gilli* (holotype).

punctate, depressed; labrum without setiferous punctures. Pronotum (Fig. 1) with marginal stria well-impressed, entire along sides and across front margin; outer lateral stria reaching from hind margin to front angles, its front end inwardly hooked and more widely separated from marginal stria; with punctures over most of surface, these punctures medium, round to oval, their interstices puncticulate and at sides microscopically punctulate. Elytron (Fig. 1) with dorsal striae marked by large, crescentiform punctures in front; stria 1 entire; striae 2 to 4 progressively shorter; stria 5 absent; sutural stria feebly sinuate, slightly farther from suture in front and at middle than behind; with one additional short stria between stria 4 and sutural stria; internal subhumeral stria reaching from front to hind margin; external subhumeral stria reaching from front to hind margin and continued briefly along hind margin; marginal elytral stria long, parallel to external subhumeral stria, briefly interrupted at middle; marginal epipleural stria absent; surface puncticulate and microscopically punctulate behind. Propygidium with surface puncticulate; front half with small, sparse, shallow punctures; hind half broadly, transversely inflated. Pygidium of males with front half punctate, these punctures coalescent and appearing striolate; of females with most of surface striolate and with median oval erosion. Prosternum (Fig. 2) with carinal striae reaching from hind margin to just before middle, joined in rather acute arch in front; lateral striae very faintly impressed at middle only; lobe closely punctate. Mesosternum (Fig. 2) with marginal stria somewhat distant from front margin, joined at sides to metasternal postcoxal striae. Metasternum (Fig. 2) with postcoxal stria strongly angulate, reaching metasternal-metepisternal suture at middle; outer lateral stria short, strongly angulate, front end near front margin, hind end joined to postcoxal stria; inner lateral stria reaching from just in front of middle to hind coxa; surface puncticulate; without large punctures except those marking striae; metepisternum puncticulate, very narrow; metepimeron striate. First abdominal sternum with inner postcoxal stria nearly straight; outer postcoxal stria long, arcuate, reaching to hind angle; surface puncticulate. Legs as in generic description; front tibia with 6 or 7 spinules. Male genitalia as in Figure 5.

REMARKS. *Voratister panamensis* may be separated from *V. gilli* by the absence of large punctures between the inner lateral striae of the metasternum; by the absence of the elytral dorsal stria five; by the round to oval punctures on the pronotum; and by the more sparsely punctate propygidium and pygidium. The pygidium of females has a median oval erosion and is more densely punctate than that of males.

Voratister gilli Helava, **new species**

Figs. 3, 4, 6

TYPE. Holotype, male, PANAMA, Gatun Lake, Barro Colorado Is., 5–7 May 1981, B. Gill (National Museum of Natural Sciences, Ottawa). Host: no data.

DESCRIPTION. Length: 1.87 mm; width: 1.56 mm. Head with vertex flat, sparsely punctate, these punctures elongate oval to irregular; frons and clypeus minutely punctate, depressed; labrum without setiferous punctures. Pronotum with marginal stria well impressed, entire along sides and across front margin; outer lateral stria reaching from hind margin to front angle, its front end inwardly hooked and more widely separated from marginal stria; with punctures over most of surface, these punctures medium, oval at middle and gradually smaller and more tear-shaped towards sides, their interstices puncticulate and microscopically punctulate. Elytron (Fig. 3) with dorsal striae marked by large, crescentiform punctures in front; striae 1 to 3 entire; stria 4 reaching to just behind middle; stria 5 shorter than stria 4, somewhat indistinct; sutural stria marked by double row of punctures for most of its length; with one additional, short stria between stria 5 and sutural stria; internal subhumeral stria long, reaching from front to hind margin; external subhumeral stria reaching from front to hind margin and continued briefly along hind margin; marginal elytral stria long, parallel to external subhumeral stria, briefly interrupted at middle; marginal epipleural stria absent; surface puncticulate and microscopically punctulate behind. Propygidium with surface puncticulate; front 0.7 with sparse, shallow punctures that gradually become smaller behind; hind 0.3 broadly, trans-

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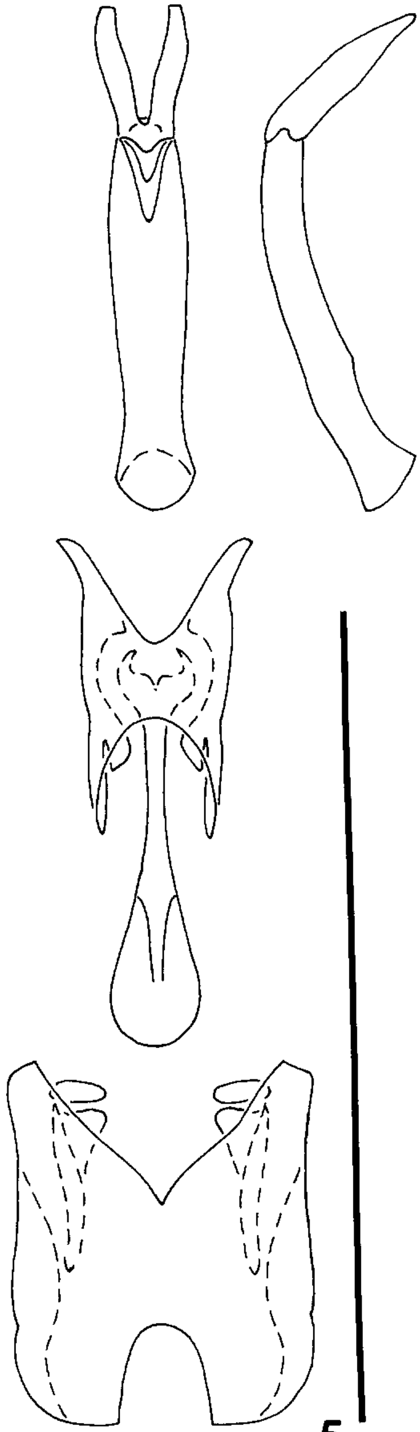
Figs. 5, 6. Male terminalia and aedeagus of species of *Voratister* spp. 5, *V. panamensis* (holotype). 6, *V. gilli* (holotype). Bars indicate one millimeter.



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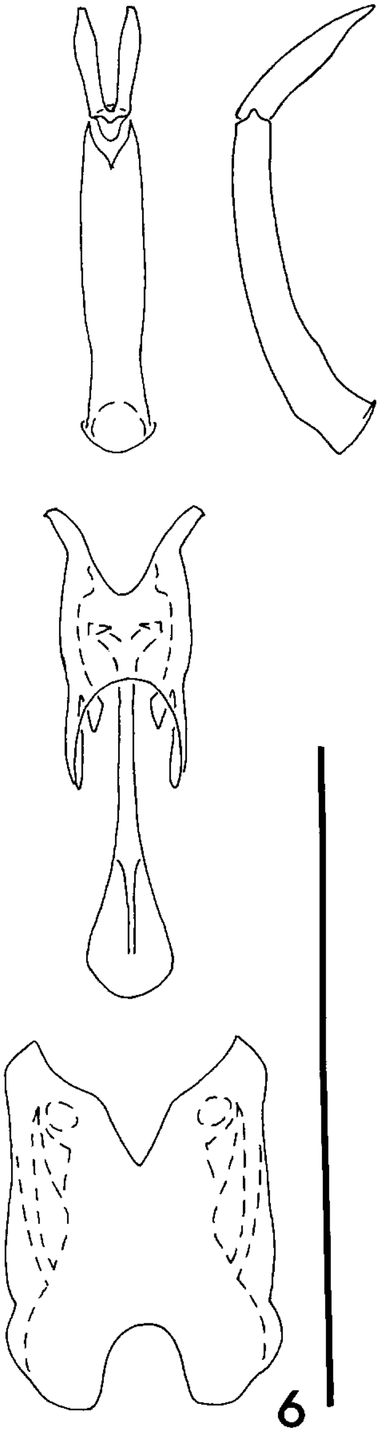

6

versely inflated. Pygidium with front half punctate; hind half with punctures becoming coalescent and appearing striolate. Prosternum with carinal striae reaching from hind margin to just before middle, joined in rather acute arch in front; lateral striae very faintly impressed at middle only; lobe closely punctate. Mesosternum (Fig. 4) with marginal stria somewhat distant from front margin, briefly interrupted at middle, joined at sides to metasternal postcoxal striae. Metasternum (Fig. 4) with postcoxal stria arcuate, reaching metasternal-metepisternal suture at middle; outer lateral stria short, feebly arcuate, not joined to postcoxal stria; inner lateral stria reaching from just in front of middle to hind coxa; surface puncticulate; with large punctures between inner lateral striae and at sides; metepisternum very narrow, puncticulate; metepimeron striate. First abdominal sternum with inner postcoxal stria neary straight; outer postcoxal stria arcuate, reaching to hind angle; surface with sparse oval punctures that become gradually smaller towards hind margin. Legs as in generic diagnosis; front tibia with 6 or 7 spinules. Male genitalia as in Figure 6.

ETYMOLOGY. This species is named in honor of Dr. Bruce Gill in recognition of the many histerids he has collected.

REMARKS. *Voratister gilli* may be separated from *V. panamensis* by the presence of large punctures between the inner lateral metasternal striae; by the presence of an elytral dorsal stria five; by punctures on the pronotum, which are oval at the middle and gradually smaller and more tear-shaped towards the sides; and by the more densely punctate propygidium and pygidium.

ACKNOWLEDGMENTS

I wish to thank Dr. H. F. Howden for the opportunity to study the histerids in his collection and Mr. L. E. C. Ling for the scanning electron photographs.

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The Coleopterists Bulletin, 43(2):127–133. 1989.

A REVIEW OF THE GENUS *POLOPINUS* CASEY (COLEOPTERA: TENEBRIONIDAE) WITH DESCRIPTIONS OF TWO NEW SPECIES

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ABSTRACT

Two new species, *Polopinus youngi* and *Polopinus hubbelli*, from Florida are described. *Polopinus nitidus subdepressus* and *Polopinus nitidus brevior* are placed as synonyms of *Polopinus nitidus*. A key to the species of *Polopinus* is presented and the evolution of the *Polopinus* species is compared with the geological history of Florida.

The genus *Polopinus* was erected by Casey (1924) to separate these more polished and larger beetles from *Polypleurus*. *Polopinus* is easily distinguished from *Polypleurus* by the poorly defined costae, more shallow punctures of the elytra, and longer and sharply pointed male genitalia. *Polypleurus* is found throughout eastern and southern United States from Maryland through Texas, while *Polopinus* is restricted to southern Georgia and Florida.

Descriptions of two new species are given herein. Abbreviations for material examined are USNM (United States Museum of Natural History), FSCA (Florida State Collections of Arthropods), and MCZC (Museum of Comparative Zoology at Harvard University).

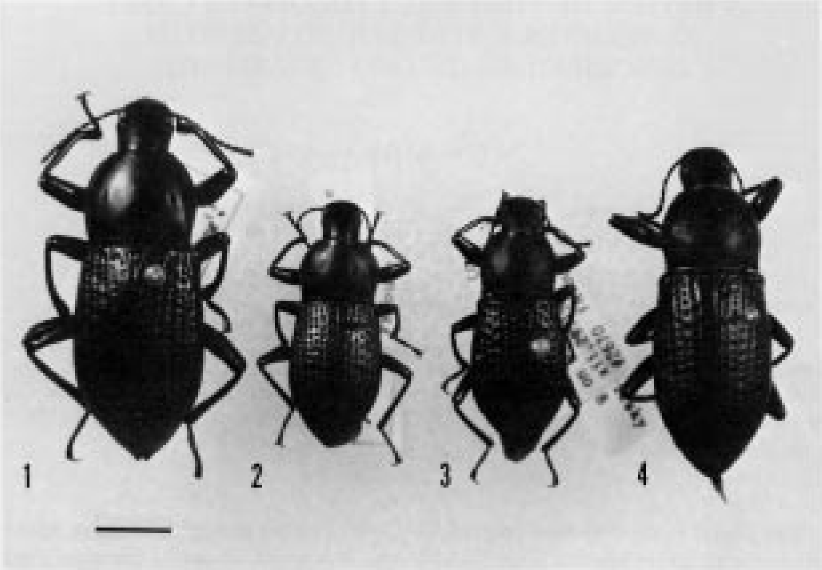
POLOPINUS CASEY 1924

Polopinus Casey 1924: 326.

DIAGNOSIS. Medium to large black beetles, 12.8–26.9 mm long. Head and pronotum smooth, finely punctate. Antennae clavate. Elytra fused, each with nine rows of punctures and with innermost row of punctures smaller than outer rows. Costae poorly defined. Parameres separate, long and narrow ending in a sharp point. Aedeagus long, narrow and sharply pointed.

KEY TO THE SPECIES OF *POLOPINUS*

1. Pronotum shiny; paramere length to width ratio less than 3.2 2
– Pronotum dull; paramere length to width ratio greater than 3.3 3
2. Basal margin of pronotum bisinuate (Fig. 6); male genitalia as in Figure 10; northeast coast to central Florida (Fig. 14) .... *nitidus* (LeConte)
– Basal margin of pronotum straight (Fig. 5); male genitalia as in Figure 9; southern Georgia to central Florida (Fig. 13) .... *ingens* Casey
3. Basal margin of pronotum sinuate (Fig. 7); male genitalia as in Figure 11; southeast and southwest coasts of Florida (Fig. 15) .... *youngi*, sp. nov.
– Basal margin of pronotum feebly sinuate (Fig. 8); male genitalia as in Figure 12; Big Pine Key, Florida .... *hubbelli*, sp. nov.



Figs. 1–4. *Polopinus* spp., habitus. 1, *P. ingens*. 2, *P. nitidus*. 3, *P. youngi*. 4, *P. hubbelli*. Scale = 5 mm.

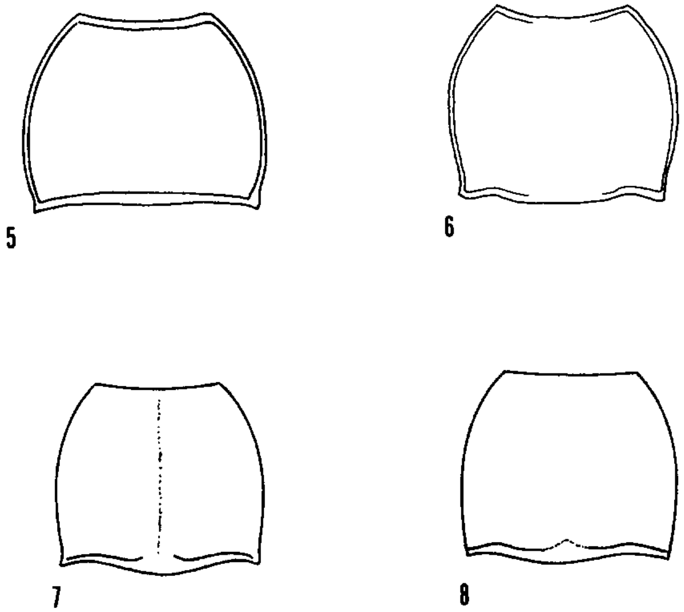
Polopinus nitidus (LeConte 1866)

Polypleurus nitidus LeConte, 1866:118–119. Holotype: Florida (MCZC), examined.
Polopinus nitidus: Casey 1924:326.
Polopinus nitidus subdepressus Casey 1924:327. Type: Florida (USNM), examined. **New synonymy.**
Polopinus nitidus brevior Casey 1924:327. Type: Crescent City, Florida (USNM), examined. **New synonymy.**

Diagnosis. Distinguished from other *Polopinus* species by the shiny, more flattened dorsum of pronotum (Fig. 2), slightly curved anterior margin and bisinuate basal margin (Fig. 6). Male genitalia (Fig. 10) similar to but smaller than those of *ingens*. Parameres about 3.1× as long as wide. Holotype 18.5 mm long, but other specimens as small as 12.8 mm.

Remarks. Additions to original description: pronotum about 0.88× as long as wide; elytra about 1.74× as long as wide, about 2.3× as long as pronotum, and about 1.18× as wide as pronotum.

The distribution of *nitidus* is shown in Figure 14. This species exhibits local variation in the shape of the pronotum. Indeed, it is likely that one could determine the locality of an unlabeled specimen after having examined a large number of specimens. The holotype is most like specimens of *nitidus* from the northeastern part of Florida. Casey (1924) described two subspecies of *nitidus*, *P. nitidus subdepressus* and *P. nitidus brevior*, which reflect this pronotal variation.



Figs. 5–8. *Polopinus* spp., pronotum. 5, *P. ingens*. 6, *P. nitidus*. 7, *P. youngi*. 8, *P. hubbelli*.

I have seen two specimens of *Polopinus* labeled Illinois, but these records need to be confirmed before extending the range.

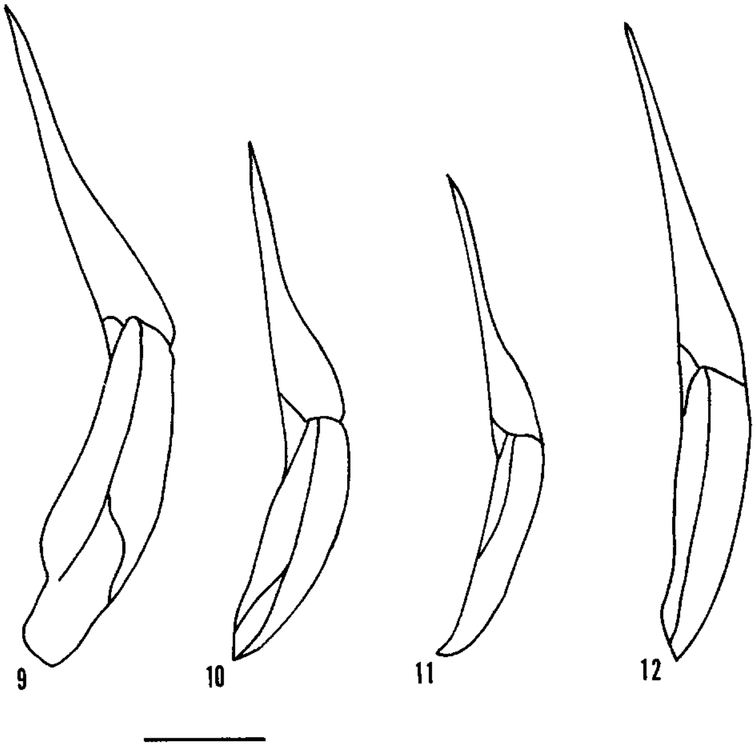
Polopinus ingens Casey 1924

Polopinus ingens Casey 1924:327. Holotype: Florida (USNM), examined.

Diagnosis. Largest *Polopinus* species (Fig. 1) with some individuals 26.9 mm long. Differs from *nitidus* by the nearly straight basal margin of pronotum (Fig. 5) and larger, more robust male genitalia (Fig. 9).

Remarks. The distribution of *ingens* is illustrated in Figure 13. *Polopinus ingens* exhibits clinal variation from southern Georgia to central Florida with individuals becoming progressively smaller in the southern populations. Table 1 shows the clinal variation in pronotal length and width.

The clinal variation of *ingens* combined with the localized variation in the pronotum of *nitidus* presented a problem of verifying that the two species are indeed distinct and not representative of a widespread polymorphic species. The fact that these beetles are wingless may have limited the gene flow from local populations thus contributing to the evolution of the cline seen within *ingens* and the variation seen within *nitidus* populations. The solution to the species problem was found by examining areas where the two species overlap. Collections from Putnam and Polk counties in Florida were statistically examined using the methods described by Gabriel and Sokal (1969) to examine geographic variation. Beetles from these counties of overlapping distribution were classified using key characters and the lengths and widths of the apex and



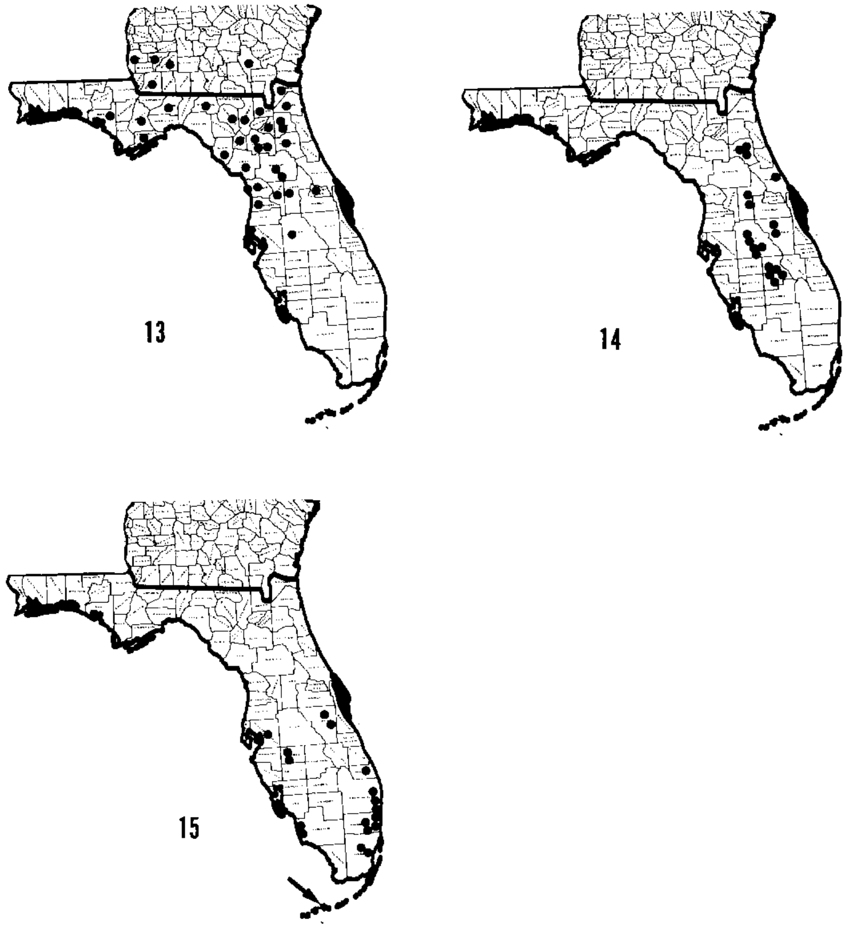
Figs. 9–12. *Polopinus* spp., lateral view of the male genitalia. 9, *P. ingens.* 10, *P. nitidus.* 11, *P. youngi.* 12, *P. hubbelli.* Scale = 1 mm.

base of the pronotum and elytra were found. ANOVA analysis found that the beetles belong to two distinct populations. When individuals of *nitidus* from these overlapping counties were compared to other *nitidus* populations which do not overlap with *ingens* they were found to belong to the same statistical population, supporting the view that *nitidus* is a distinct entity separate from *ingens.*

Polopinus youngi Kritsky, **sp. nov.**

Diagnosis. Similar to *nitidus,* but differing in opaque and more convex pronotum (Figs. 3, 7). Male genitalia (Fig. 11) more slender than those of *nitidus* (Fig. 10). Length 13.20–20.00 mm.

Description. Color black; surface dull with minute punctures. Eyes reniform with 12 facets across dorsum, 7 facets across midline, and 6 facets across ventral portion. Pronotum (Fig. 7) about 0.85 × as long as wide, with anterior margin slightly deflexed, base sinuate, sides arcuate. Scutellum triangular. Elytra about 1.6 × as long as wide, about 2.35 × as long as length of pronotum, about 1.25 × as wide as width of pronotum. Front coxae separated by about 1.2 × coxal length, middle coxae separated by about 1.2 × coxal length, and hind coxae separated by about 0.7 coxal length. Male genitalia (Fig. 11) with parameres about 3.7 × as long as wide, basal piece about 2.2 × as long as wide. Holotype 15.75 mm long.



Figs. 13–15. Distribution maps for *Polopinus* spp. in southern Georgia and Florida. 13, *P. ingens*. 14, *P. nitidus*. 15, *P. youngi* (dots) and *P. hubbelli* (arrow).

TYPE MATERIAL. Holotype male. FLORIDA, Broward Co., vi.6.1949. F. N. Young (FSCA).

Specimens examined: 225 paratypes. **Florida:** *Broward Co.:* vi.6.49, F. N. Young; scrub near Oakland Pk., ix.6.53, F. N. Young; near Oakland Park scrub, ix.4.53, F. N. Young; near New River on US 441 scrub, ix.6.53, F. N. Young; scrub at Ft. Lauderdale, xii.31.74, F. N. Young; Pompano Beach, xii.5.59, F. N. Young; Boca Raton on *Quercus,* xi.30.31, C. D. Link. *Collier Co.:* scrub fragment in Naples on US 41, vi.12.76, F. N. Young; viii.30.51, F. N. Young; Estero, i.3.65, B. K. Dozier. *Dade Co.:* Miami, 1.1.33, F. N. Young; Miami, v.25.36; v.1951. *Hardee Co.:* turkey oak 1.2 mi. N. Gardner, US 17, vi.12.76, F. N. Young; S. of Zolfo Springs, turkey oak, viii.27.53, F. N. Young. *Martin Co.:* vi.8.49, F. N. Young. *Osceola Co.:* turkey oak near Kennansville, vi.26.76, F. N. Young; scrub 1.2 mi. N. Yeehaw Jct.–US 441, vi.26.76, F. N.

Table 1. Pronotal length and width of *Polopinus ingens* populations.

State, County	Mean pronotal length	Mean pronotal width	Sample
GA, Decatur Co.	6.74 mm	7.59 mm	10
FL, Gilchrist Co.	5.78 mm	6.47 mm	7
FL, Polk Co.	5.45 mm	5.82 mm	11

Young. *Palm Beach Co.:* scrub at Boca Raton on US Highway 1, xii.29.75, F. N. Young; scrub at Boca Raton on US Highway 1, xii.31.75, F. N. Young; scrub at Boca Raton on US Highway 1, vi.13.76, F. N. Young; near Boca Raton on US 1–cleared scrub, xii.28.74, F. N. Young; Boca Raton, North of Co. Line–US 1, vi.18.77, F. N. Young; Loxahatchee, Oct. 29–30, 1934, T. H. Hubbell; W. Palm Beach, 4-13-48, P. Pearson; Del Ray, vii.22.50, D. Pence; Boca Raton cleared scrub along U.S. 1, vi.18.77, F. N. Young; scrub along U.S. 1, xii.28.84, Gene Kritsky (all in FSCA).

Florida: *Broward Co.:* Logwood, vi.16.58, P. A. Norman. *Dade Co.:* Coral Gables, xi.1.27, Bailey; vi.1949; Miami-Everglades, ii.1950, G. Frey; Miami Beach, iv.9.18, T. E. Snyder. *DeSoto Co.:* Arcadia, iv.2.53, H. E. Evans. *Hendry Co.:* La Belle, vii.16.39, Oman. *Manatee Co.:* Oneco, iii.29 to iv.4.1953. *Monroe Co.:* Key Largo (no other data); Palm Beach Co., Lake Worth, 1889, L. B. Parker; Latonia, xii.15.28 (all in USNM).

REMARKS. The distribution of *youngi* is given in Figure 15. *Polopinus youngi* overlaps with *nitidus* in Osceola County. Examination of specimens of both species from this county show that *nitidus* is easily distinguished from *youngi* by the characters described in the diagnosis.

Polopinus hubbelli Kritsky, **sp. nov.**

DIAGNOSIS. Similar to *youngi* but larger (Fig. 4). Pronotum (Fig. 8) more convex, apex more deflexed than in *youngi*, base not as sinuate as *youngi*. Male genitalia like *youngi* but proportionately larger and more slender (Fig. 12). Length 18.4–22.9 mm.

DESCRIPTION. Color black; surface dull with minute punctures. Eyes similar to those of *youngi* with about 10 facets across dorsum, about 5 facets across midline, 8 facets across ventral portion of eye. Pronotum about 0.84× as long as wide, with anterior margin straight, base sinuate, sides arcuate (Fig. 8). Scutellum broadly triangular. Elytra with sides more parallel than in *youngi*, about 1.75× as long as wide, about 2.5× as long as pronotal length, about 1.15× as wide as pronotum. Front coxae separated by about 1.3× coxal length, middle coxae separated by about 0.9× coxal length, and hind coxae separated by about 0.6× coxal length. Male genitalia (Fig. 12) with parameres about 4.5× as long as wide, basal piece about 2.3× as long as wide. Holotype 22.0 mm long.

TYPE MATERIAL. Holotype male. FLORIDA, Monroe Co., Big Pine Key Pinelands N. end, viii.23.53. F. N. Young (FSCA).

Specimens examined: 134 paratypes. **Florida:** *Monroe Co.:* Big Pine Key, Pinelands N. end, viii.28.51, viii.23.53, viii.24.53, F. N. Young; Big Pine Key, viii.9.51, F. N. Young; Big Pine Key, North end, viii.22.55, F. N. Young; Pinelands, viii.24.53, F. N. Young; Big Pine Key, 20.xi.58, R. E. Woodruff; Big Pine Key, under bark of Pinus, 31.xii.57, W. W. Warner; Big Pine Key 4-8-48, E. D. MacRae; under log, 3. iv.63, H. V. Weems; under cardboard, 10, iv.59, H. V. Weems; Center Big Pine Key, iv.8.48, E. D. MacRae (all in FSCA).

This species is known only from Big Pine Key, Florida (Fig. 15).

DISCUSSION

Florida during the past 4 million years provided several opportunities for allopatric speciation. In the Pliocene, Florida was a much smaller peninsula which included what is now the Florida-Georgia border region with a narrow peninsula extending southward to what is now about the middle of the state. Southern Florida was a pseudoatoll, a ring of coral islands that formed as a result of a meteorite impact in the late Eocene and subsequent sea level changes creating conditions for coral growth on the rim of the impact crater (Petuch 1987). By the end of the Pliocene, the Florida peninsula had grown southward to connect with the northernmost section of the pseudoatoll.

Polopinus ingens is found on what was the ancient Florida peninsula. *Polopinus nitidus* is distributed over what was the northeastern islands and the extension of the Florida peninsula which occurred between 4 and 2 million years ago. The pseudoatoll, which now forms the coast of south Florida, corresponds to the current distribution of *youngi. Polopinus hubbelli* is restricted to the Florida keys which likely formed within the last 100,000 years.

The zoogeography of the four species suggests how the species evolved. Ancestral *Polopinus* populations on the ancient peninsula dispersed to the newly forming islands of the northeast and the islands which formed on the pseudoatoll. Since *Polopinus* is often found under bark, rafting is a likely candidate for the means of dispersal. Descendants of the ancestral population which remained on the ancient peninsula gave rise to *ingens.* The beetles which successfully reached the newly forming islands of the northeast part of Florida gave rise to *nitidus,* while those individuals who colonized the islands forming on the pseudoatoll were ancestral to *youngi.* The geological evidence would indicate that *nitidus* may be between 2 and 4 million years old, with *youngi* no more than 2 million years old. *Polopinus hubbelli* is the youngest of the *Polopinus* species having evolved since the formation of the Florida Keys within the last 100,000 years.

ACKNOWLEDGMENTS

I am extremely grateful to Dr. Frank N. Young for the opportunity to examine his extensive collections of *Polopinus* and his encouragement since I was an undergraduate student. I also thank Drs. Thomas E. Moore, Robert Woodruff, Frank M. Carpenter, and Mr. T. J. Spilman for the loan of material. I also thank Dr. Charles Triplehorn for his comments on the manuscript and Dr. Edward Petuch of the Department of Geology at Florida Atlantic University for his hours of discussions on the geological history of Florida.

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INTERNATIONAL CONGRESS OF COLEOPTEROLOGY

The first International Congress of Coleopterology, sponsored by the European Association of Coleopterology, meets in Barcelona, Spain, 18-23 September 1989. Invited lecturers are:

Prof. R. A. Crowson—Relation between Coleoptera and Cycads.
Prof. G. Halffter—La evolución del comportamiento de los Insectos: el ejemplo de los Scarabaeidae coprófagos.
Prof. S. B. Peck—Evolution and biogeography of the beetle fauna of the Galápagos Islands, Ecuador.
Prof. E. Petitpierre—Chromosomal and genomic evolution in two families of Coleoptera (Chrysomelidae and Tenebrionidae).

The deadline for registration and submission of title of paper or poster was given as **15 April 1989** (unfortunately this information was received after the March issue was in press). It is probably not too late to consider attending. The registration fees are US$70.00 for members and US$20.00 for students. The brochure did not specify whether members referred to members of the congress or members of the association. For more information, write to Asociación Europea de Coleopterología, Departamento de Biología Animal (Invertebrados), Facultad de Biología, Universidad de Barcelona, Avda. Diagonal, 645, 08028 Barcelona, SPAIN.

REPORTS OF NOMINATING AND EDITOR SEARCH COMMITTEES

The following members have agreed to stand for the 1989 election for officers; one President-elect and three Councilors are to be elected.

President-elect—Ed Balsbaugh, Fargo, ND
—Mike Ivie, Bozeman, MT
Councilors—Tom Atkins, Gainesville, FL
—Paul Johnson, Madison, WI
—Dave Kavanaugh, San Francisco, CA

Submitted by the Nominating Committee: Fred Andrews (chair), Gary Dunn, and Dave Furth.

Editor—Lee Herman, New York, NY

Submitted by the Editor Search Committee: Paul Johnson (chair), John Bouseman, and Gary Dunn.

Additional nomination(s), supported by five members and permission of nominee(s), should be sent to the Secretary Don Bright before **15 September 1989.**

The Coleopterists Bulletin, 43(2):135–144. 1989.

A SYNOPSIS OF THE GENUS *AREODA* (COLEOPTERA: SCARABAEIDAE: RUTELINAE)

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ABSTRACT

The three species in the genus *Areoda* are reviewed for the first time. The genus is characterized, a key to species is provided, each species is described, spatial and temporal distributions are given, and the biogeography is discussed. We consider their distribution to be isolated and relictual in the Atlantic coastal forests of southeastern Brazil.

RESUMO

As três espécies do gênero *Areoda* são revisadas pela primeira vez. O gênero é caracterizado, é dado uma chave para as espécies, cada espécie é descrita, distribuições espaciais e temporais são dadas, e um comentário breve discute a biogeografia destes besouros. Nós consideramos suas distribuições sejam isoladas e relituiais na costa da floresta Atlântica no suleste do Brasil.

The genus *Areoda* Macleay is comprised of three species: *A. banksi* Laporte, *A. espiritosantensis* Ohaus, and *A. leachi* Macleay. These distinctive beetles are found only in the Atlantic coastal forests of southeastern Brazil from the states of Bahia in the north to Santa Catarina in the south. The genus *Areoda* is placed in the subtribe Areodina (of the Rutelini) because it has a complete frontoclypeal suture and externally rounded mandibles. In appearance, these highly convex beetles are similar to some species of *Platycoelia* Burmeister (Neotropical) and *Anoplognathus* Leach (Australian), both of the latter belonging, however, to the tribe Anoplognathini. *Oplognathus* Macleay (not *Hoplognathus* as in Burmeister 1844; Ohaus 1918, 1934; Blackwelder 1944) consists of three species, occurs in the same area, is an areodine, and is somewhat similar to *Areoda*. *Oplognathus* is smaller and has other characters (including clypeus, color, and pattern) that separate it from *Areoda*. Some sympatric species of *Byrsopolis* Burmeister closely resemble *Areoda*, but they may be separated by the absence of a mesosternal peg in *Byrsopolis*. Moreover, *Areoda* is the only genus of New World Areodina with highly asymmetrical parameres (Figs. 2–4).

Specimens of *Areoda* are not well represented in collections, especially those in North America. There has never been a published key to the species of *Areoda* nor have the species had a modern description. Until now, there has been no reliable or convenient way to identify them. Ohaus (1934) provided the most recent key to genera in the subtribe Areodina, but in that work, several genera now considered valid are parts of the genus *Cotalpa* Burmeister (*Byrsopolis*, *Parabyrsopolis* Ohaus, and *Paracotalpa* Ohaus). *Areoda magnifica* Nonfried (1891), allegedly from Brazil, was assigned to the Australian species, *Anoplognathus analis* Dalm, by Ohaus (1905) after he examined the type. Laporte (1840) referred to an *Areoda lanigera* F., but this is *Cotalpa lanigera* (L.).

GENUS *AREODA* MACLEAY

Areoda Macleay 1819:158.

TYPE SPECIES. *Areoda leachi* Macleay by monotypy.

DESCRIPTION. Scarabaeidae, Rutelinae, Rutelini, Areodina. *Form:* Ovate, robust, dorsum very convex, apex of elytra broadly rounded. Length 19–31 mm. Width across humeri 11–20 mm; widest width 12–20 mm. *Color:* Preserved specimens dorsally testaceous to reddish brown, with brassy or metallic green reflections; ventrally piceous with metallic green reflection; live specimens creamy white to opalescent, with golden or greenish reflections. *Head:* Clypeus subequal in length to frons; apex broadly, weakly rounded, narrowly reflexed. Eyes large, interocular width equals 3 transverse eye diameters in males, a little wider in females. Antenna with 3-segmented club; club slightly longer than segments 2–7. Labrum emarginate apically, densely setigerous. Mandibles broadly rounded externally, hidden in dorsal view. Mentum with apex weakly sinuate, length approximately 1.5 times width of apex. Maxillary palpi with terminal segment enlarged or not. *Pronotum:* Widest at base. Lateral margins broadly rounded. Marginal bead complete or effaced basomedially. Surface variably punctate. *Scutellum:* Parabolic, slightly wider than long; length $\frac{1}{10}$–$\frac{1}{11}$ length of elytral suture. Surface variably punctate. *Elytra:* Surface with obsolete to distinct, punctate striae. Suture cariniform apically, apex right-angled. *Pygidium:* Surface densely rugulose, a few sparse setae present or not. *Venter:* Surface densely, setigerously punctate to rugopunctate; setae fine, moderate in length. Mesosternal process triangular, extending anteriorly to forecoxae or not. *Legs:* Foretibia tridentate, anterior tooth slightly removed from others, teeth becoming smaller posteriorly. Foretarsus in male with large claw 2–4 times wider than small claw (at widest points as seen from above). All claws simple. *Parameres:* Asymmetrical, bearing 3 projections.

DIAGNOSIS. *Areoda* may be distinguished from other Rutelinae on the basis of the following characters: 10-segmented antennae, labrum separated from clypeus and horizontal with respect to clypeus, mandibles rounded externally with apexes not reflexed, complete frontoclypeal suture, a forward-projecting mesosternal process, and a broadly rounded clypeal apex.

Males can be recognized by their relatively concave abdominal sternites, whereas females have sternites slightly convex or tumescent. Males have an enlarged foreclaw that is 2–4 times wider than the smaller claw, whereas females have these claws subequal in size. Males have the last sternite apically emarginate, and females have the last sternite entire. Finally, males are generally smaller than females.

KEY TO THE SPECIES OF *AREODA*

1. Mesosternal process extending anteriorly to between forecoxae (with forelegs in normal position). Males with terminal segment of labial palpi not enlarged, not wider than scape of antenna. Parameres as in Figures 3 or 4 2
1′. Mesosternal process short, extending forward only slightly beyond mesosternal coxae. Males with apical segment of labial palpi enlarged, wider than antennal scape. Parameres as in Figure 2 .... *banksi* Laporte
2. Elytra lacking well-defined or impressed striae. Color of pygidium weakly metallic, dark olive green to unaided eye. Parameres as in Figure 3 .... *espiritosantensis* Ohaus
2′. Elytra with well-defined striae. Color of pygidium bright metallic green to unaided eye. Parameres as in Figure 4 .... *leachi* Macleay

Areoda banksi Laporte
(Figs. 1, 2, 5)

Areoda banksii Laporte 1840:128.

DESCRIPTION. Length 25.3–28.6 mm; width across humeri 13.5–16.9 mm; greatest width (mid-elytra) 15.1–19.4 mm. *Head:* Color of frons testaceous or brassy green with metallic reflection; clypeus reddish brown. Frons with surface densely punctate; punctures small posteriorly, becoming moderately large, deep, and dense anteriorly. Clypeus with surface densely punctate, punctures moderately large, deep; apex broad, weakly rounded, narrowly reflexed. Labial palpus in male with terminal segment large, wider than scape of antenna; female with palpus narrower. *Pronotum:* Color reddish brown to testaceous with dull metallic or brassy green reflection. Surface with small and moderate punctures mixed, punctures becoming denser and larger laterally. Marginal bead complete. *Elytra:* Color testaceous to reddish brown, with shining or brassy green reflection. Surface with variably defined punctate striae: 1 adjacent to suture, 2 on center of disc, 2 just mesad of humerus, 2 near lateral margins; punctures of striae large. Intervals shagreened, irregularly and moderately punctate, punctures small. *Pygidium:* Color weakly metallic, dark olive-green. Surface densely rugulose with a few small setae apically. *Venter:* Color piceous with light to dark metallic green reflection. Mesosternal process triangular, not elongate, not extending to between forecoxae when legs in normal position. *Legs:* Foretarsus in male with large claw 3–4 times thicker than narrow claw (at widest points as seen from above). *Parameres:* Figure 2.

REMARKS. *Areoda banksi* is easily recognized because of its short mesosternal process, distinctive parameres, and males with the terminal segment of the labial palpi greatly enlarged.

The type specimen for *A. banksi* is probably lost (R. P. Dechambre, pers. comm. 1987). Nomenclatural stability would not be enhanced in this genus by designation of a neotype, and we refrain from doing so.

Ohaus (1908) reported that *A. banksi* was sympatric with *A. leachi,* but that *A. banksi* preferred moist forests. He observed caged adults feeding on bananas and the flowers of *Inga* and *Bohemeria.* Ohaus also noted that this species hid during the day, but was active at night. He was unsuccessful in getting them to copulate or produce young.

LOCALITY RECORDS (Fig. 5). Specimens examined (28). **Minas Gerais** (1): Entre Rios. **Rio de Janeiro** (12): Petropolis, no data. **São Paulo** (2): no data. No data (13).

TEMPORAL DISTRIBUTION. January (1), April (1), September (1), November (1). Ohaus (1908) collected great numbers of them from the beginning of January to mid-February (1898) at electric lights. The first specimen was taken on 6 November, and only a few specimens were found after mid-February.

Areoda espiritosantensis Ohaus
(Figs. 3, 5)

Areoda espiritosantensis Ohaus 1905:322.

DESCRIPTION. Length 23.5–30.9 mm; width across humeri 13.1–17.0 mm; greatest width (at or just behind middle) 15.2–19.5 mm. *Head:* Color of frons reddish brown with metallic olive green or brassy green reflection; clypeus colored as frons in males, piceous (non-metallic) in females. Surface of frons densely punctate; punctures small to moderate in size near vertex, becoming moderately large, deep, nearly confluent at frontoclypeal suture. Clypeus with surface completely, densely punctate to rugopunctate; punctures moderately large, deep; apex broad, subtruncate to faintly emarginate medially, narrowly reflexed. Last segment of labial palpus normal, not as wide as scape of antenna; narrower in female. *Pronotum:* Color light yellowish brown, weakly shining to occa-

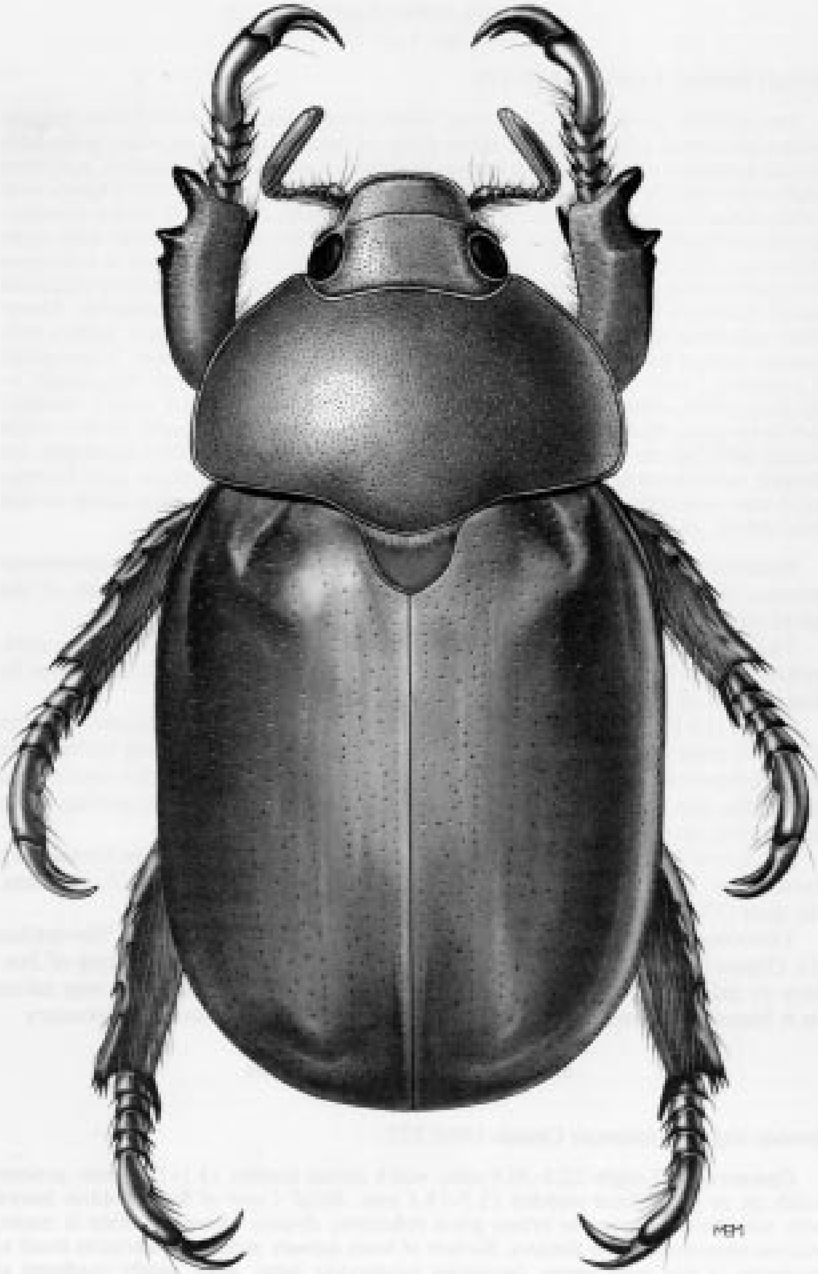
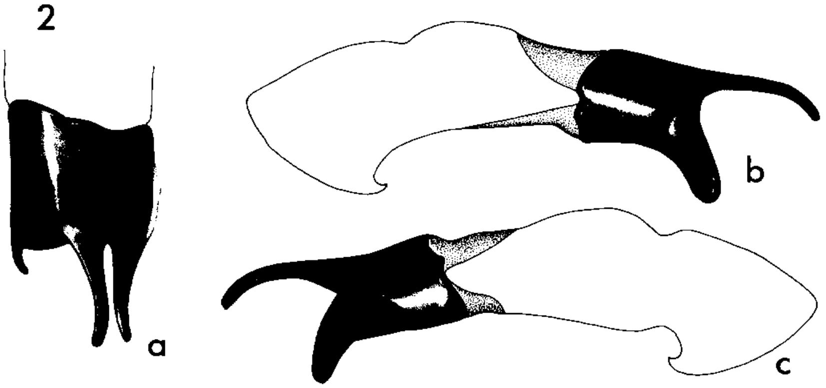


Fig. 1. Habitus of *Areoda banksi* Laporte.

2



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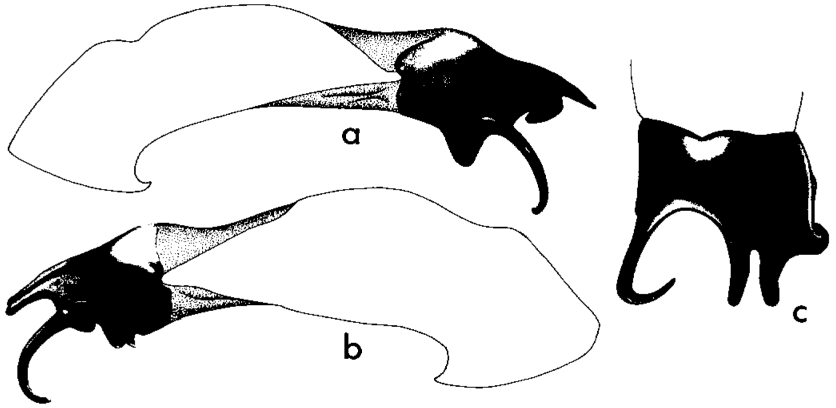

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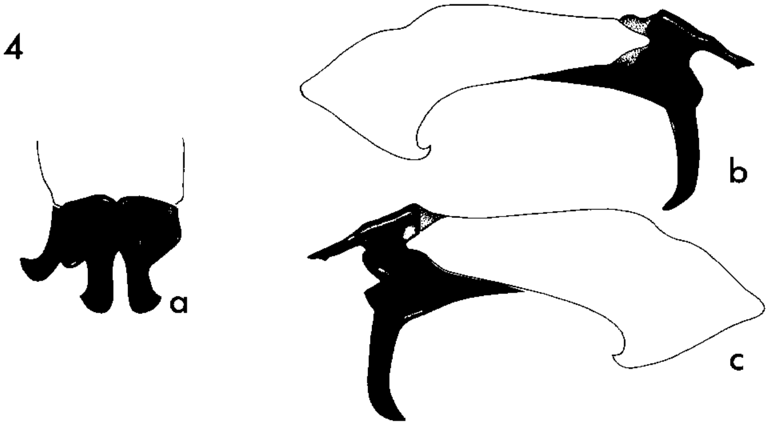

Figs. 2–4. *Areoda* spp., parameres: caudal (2a, 3c, 4a) and lateral views. 2, *A. banksi*. 3, *A. espiritosantensis*. 4, *A. leachi*.

sionally faintly metallic. Surface minutely shagreened laterally, entire surface densely punctate; punctures minute and small mixed. Marginal bead complete. *Elytra:* Color same as or slightly paler than pronotum. Surface minutely shagreened, with 2 discrete sizes of punctures: minute punctures dense, small punctures moderate in density. Punctate striae nearly obsolete, instead represented by faintly impressed striae next to suture, in center of disc and behind humerus. *Pygidium:* Color weakly metallic, dark olive green to unaided eye. Surface densely rugulose. *Venter:* Color weakly metallic, dark olive green. Mesosternal process elongate, triangular, extending anteriorly to between front coxae (when legs rotated anteriorly). *Legs:* Foretarsus in male with large claw 2 times thicker than narrow claw (at widest points as seen from above). *Parameres:* Figure 3.

REMARKS. *Areoda espiritosantensis* is the only species in the genus with nearly smooth elytra due to the nearly obsolete striae. It shares the dark olive green pygidium with *A. banksi,* but has a long mesosternal process and lacks an enlarged apical segment on the labial palpus.

The types for *A. espiritosantensis* are probably at the Museum für Naturkunde in Berlin. Paratypes (a male and a female) were examined from the U.S. National Museum.

LOCALITY RECORDS (Fig. 5). Specimens examined (10). **Espirito Santo** (8): Timbuhy, Mcpio. Linhares (Lagoa Mucucu). **Santa Catarina** (1): no data. No data (1).

TEMPORAL DISTRIBUTION. October (5), December (2).

Areoda leachi Macleay
(Figs. 4, 5)

Areoda leachii Macleay 1819:159.

DESCRIPTION. Length 19.5–28.6 mm; width across humeri 10.8–15.6 mm; greatest width (mid-elytra) 12.0–17.8 mm. *Head:* Color testaceous with brassy or metallic green reflection, clypeus often darker. Frons with surface densely punctate, punctures small to moderate in size. Clypeus with surface densely punctate to rugopunctate, punctures small to moderate; apex broad, weakly rounded, narrowly reflexed. Labial palpus with terminal segment not enlarged, not wider than scape of antenna. *Pronotum:* Color as head. Surface with disc moderately densely punctate, punctures small and moderate mixed, becoming confluent laterally. Marginal bead complete except basomedially where obsolete. *Elytra:* Color testaceous yellow to occasionally reddish brown, with metallic or brassy green reflection, reflection less pronounced than pronotum (due to coarser punctation of elytra). Surface with loosely defined punctate striae: 1 adjacent to suture, 2 on center of disc, 2 just mesad of humerus, 2 near lateral margin; punctures on striae moderately large. Intervals finely shagreened, irregularly, moderately punctate, punctures small. *Pygidium:* Color usually bright metallic green to unaided eye. Surface densely rugulose with a few small setae at apex. *Venter:* Color piceous with strong metallic green reflection (metallic green to unaided eye). Mesosternal process elongate, triangular, extending anteriorly to between forecoxae (when legs in normal position). *Legs:* Color reddish brown with metallic green reflection. Foretarsus in male with large claw 2 times thicker than narrow claw (at widest points as seen from above). *Parameres:* Figure 4.

REMARKS. Aside from distinctive parameres, *A. leachi* is the only species of *Areoda* with a bright metallic green pygidium. Ohaus (1908) stated that live specimens were a beautiful milky white or opalescent color with metallic reflections of copper, gold, or green. After death, a dirty yellow color replaced the white.

We consider the only specimen of *A. leachi* in the Macleay Museum at the University of Sydney in Australia to be the holotype, and we have so labeled it. George Masters, curator of the collection from 1872 to 1912, relabeled many

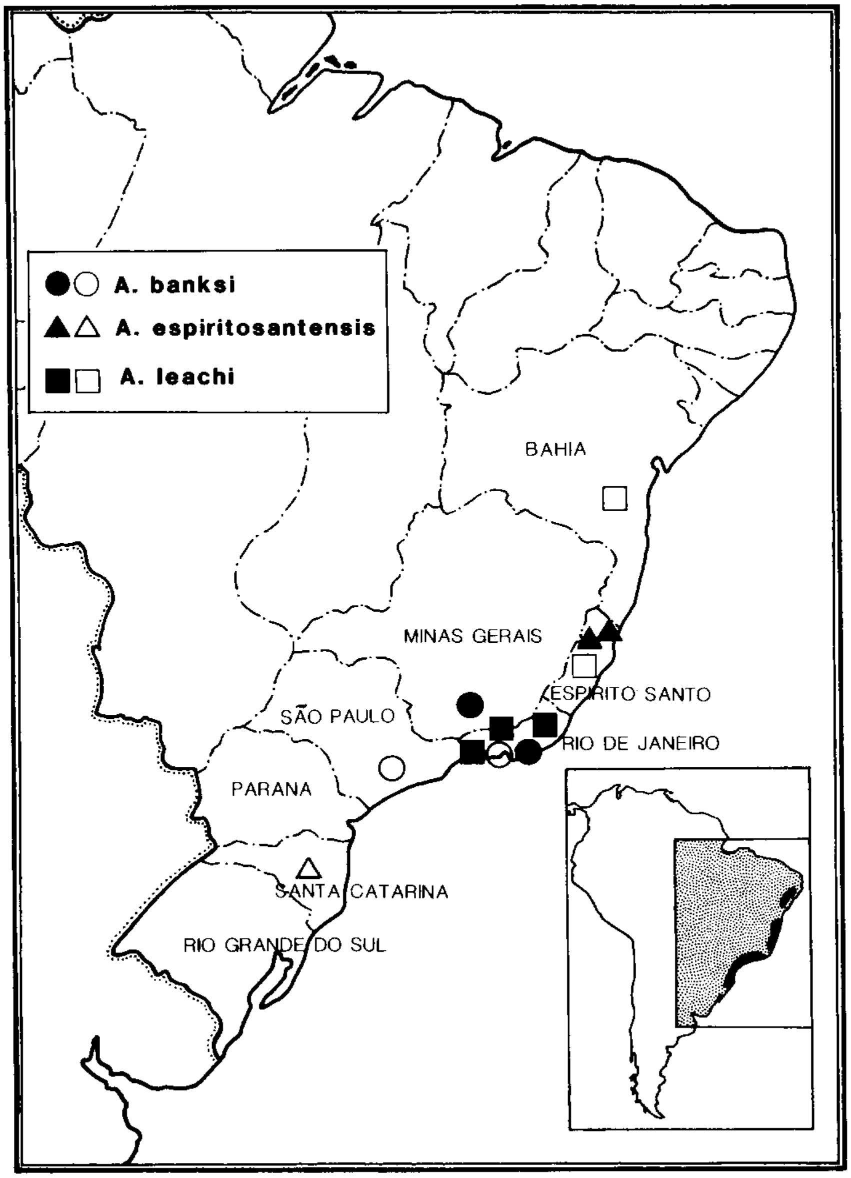

Fig. 5. *Areoda* spp. distribution map. Inset shows area enlarged (stippled) and Serra do Mar refugia (black). Dark symbol equals point data, open symbol indicates state record only.

of those insects and destroyed the original labels making it difficult or impossible to ascertain type material (D. S. Horning, pers. comm. 1987; Arnett *et al.* 1986). The specimen is a male, but it lacks any internal organs in the abdomen; the genitalia were apparently removed previously.

Label data indicate that specimens have been taken at mercury vapor lights at elevations of 900–1,000 meters. Ohaus (1908) observed that this species, unlike *A. banksi,* preferred the hot coastal valleys from Rio de Janeiro to São Paulo or the higher, hot and dry mountains near Petropolis. He indicated that during the day adults hide in the ground or beneath the leaves of low bushes. At dusk they become active. With about 30 caged male and female specimens he observed frequent copulation, but no eggs were produced. Caged specimens fed on the flowers of *Inga* and *Bohemeria* and on bananas.

LOCALITY RECORDS (Fig. 5). Specimens examined (35). **Bahia** (1): no data. **Espirito Santo** (1): no data. **Rio de Janeiro** (14): Teresopolis, km 50 estrada Contorno-Petropolis; no data. **São Paulo** (3): no data. No data (16).

TEMPORAL DISTRIBUTION. January (1), September (1), November (13), December (1). Ohaus (1908) collected his first specimen on 28 October (1888), and large numbers were taken between 31 October and 19 November in the high mountains near Petropolis.

BIOGEOGRAPHY

The forest associations in Brazil belong to two distinct main groups: Amazon forest and Atlantic forest (Bigarella and Andrade-Lima 1982). The genus *Areoda* is found exclusively in the Atlantic forests on the southeastern coast of Brazil in a region known as the Serra do Mar. *Areoda* is a biogeographical relict that has become isolated because of past geological and climatological events. It is not a phylogenetic relict in the sense of its being the lone survivor of more primitive forms; there are, in fact, other closely related areodine genera in northern South America.

The Serra do Mar was first postulated as a refugium by Vanzolini (1967), and evidence is continually increasing in support of his hypothesis. The southeastern coastal forests of Brazil are notable for a large number of endemic birds (Haffer 1974), reptiles (Müller 1973), primates (Kinzey 1982), and insects. The darkened areas on the inset map (Fig. 5) show these postulated refugia in the Serra do Mar region. Just within the scarab subfamilies Rutelinae and Dynastinae, for example, we note the following genera endemic to this region: *Areoda, Crathoplus,* and *Chalcentis* (Rutelini); *Mimogeniates* and *Microchilus* (Geniatini); *Aceratus* (Pentodontini); *Antodon* (Agaocephalini); and *Trioplus* and *Platyphileurus* (Phileurini). A lengthy list of additional insect genera could be formulated. The point is, of course, that the Serra do Mar is a distinct center of endemism. The distribution of the species of *Areoda* coincides with this center. Inasmuch as endemism suggests geographic isolation of the taxa involved, we need to now consider why or how this isolation occurred.

We suggest that climatic fluctuations during the Pleistocene were directly responsible for the isolated populations seen today in the genus *Areoda.* Pleistocene fragmentation of formerly continuous ranges by climatic and subsequent vegetational changes has been frequently discussed in the literature (Brown 1977; Brown *et al.* 1974; Endler 1982*a, b*; Haffer 1969, 1978, 1982; Livingstone 1982; Mayr and O'Hara 1986; Müller 1973; Prance 1973, 1982). Fragmentation and isolation of biotas can cause extinction, survival without change, or opportunities for speciation. In the case of what we observe in *Areoda* today, past changes in habitat, consisting largely of increased aridity during glaciations, have restricted the species to the coastal forests of the Serra do Mar.

The southeastern coastal forests of Brazil, especially in southern Bahia and Espirito Santo, are being rapidly destroyed by mankind's activities. This tragedy is ironic since the Serra do Mar has served as a *refuge* through the millennia for its endemic and little-known biota. In our view, the species of *Areoda,* along with many other unique plants and animals of the region, are in imminent danger of extinction.

ACKNOWLEDGMENTS

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SCIENTIFIC NOTE

PARALISPINUS MARIAE HATCH (COLEOPTERA: STAPHYLINIDAE: OSORIINAE) TRANSFERRED TO GENUS *STICTOCRANIUS* (EUAESTHETINAE)

When he described his new species *Paralispinus mariae* from Marys Peak, Benton County, Oregon, Hatch (1957:245) noted that this species "may be generically distinct" from the two other species he placed in *Paralispinus* Bernhauer, a preoccupied name for a genus now known as *Clavilispinus* Bernhauer (Blackwelder 1952). *Clavilispinus* and the other species included by Hatch (1957) were correctly placed by Hatch in the osoriine tribe Lispinini (based on my examination of types of those species, as well as the type species of *Clavilispinus*), but Hatch's doubts about the placement of *P. mariae* understate the problem.

In connection with a review of the higher classification of Osoriinae, I have examined types of a number of problematic taxa including *Paralispinus mariae.* The holotype (and only specimen known to me) of this species, now in the California Academy of Sciences in San Francisco, lacks the abdomen and left elytron, evidently lost sometime between Hatch's description and the time I received the type on loan. Nevertheless, the structure of the head and thorax clearly indicates that the specimen belongs in the staphylinid subfamily Euaesthetinae, and is a member of the genus *Stictocranius* LeConte (see description and figure in Moore and Legner 1979). The following combination is therefore proposed: *Stictocranius mariae* (Hatch), **new combination.**

The genus *Stictocranius* currently includes two species: *S. chinensis* Puthz (1974*a*) from western Szechwan province, China; and *S. puncticeps* LeConte, widespread in Appalachian forests of the eastern United States (map in Puthz 1974*b*) and recently found as far west as the Ozarks (NEW RECORD: Devil's Den State Park, Washington County, Arkansas, 14 November 1974, ex litter from deep crevices, A. Newton and R. Chenowith—first record west of Mississippi River). In Puthz's (1974*a*) key to distinguish these two species, *S. mariae* agrees completely with *S. puncticeps.* Comparison of the incomplete type of *S. mariae* with a series of specimens of *S. puncticeps* (including types) shows that these species are extremely similar in all externally visible characters. However, the type of *S. mariae* is slightly out of the range of variation shown within *S. puncticeps* in two characters, namely in having the punctures of the vertex of the head somewhat smaller (separated by more than one puncture diameter on average, rather than one diameter or less) and the eyes slightly smaller. On the basis of these slight differences, it is difficult to judge whether the type of *S. mariae* represents a distinct species or geographical variation within *S. puncticeps.* Until more specimens of *S. mariae* become available and genitalia can be compared, it seems best to recognize *S. mariae* as a valid species, geographically widely separated from its very similar close relative, *S. puncticeps* of the eastern United States.

I thank Roberta Brett for prompt loan of the type of *S. mariae,* James Digiulio of Oregon State University for directing me to CASC, and Steve Ashe and Margaret Thayer for commenting on the manuscript.

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BOOK REVIEW

Costa, C., S. A. Vanin, and S. A. Casari-Chen. 1988. **Larvas de Coleoptera do Brasil.** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil. 280 × 215 mm. 282 pp., 146 line plates, 19 half-tone plates. Hard cover. US $65.00.

This very handsome volume contains descriptions and very good detailed figures of 146 species of Coleoptera larvae occurring in Brazil, representing 71 families, together with a key which uses 278 couplets to distinguish 109 families, and a short anatomical introduction. Adults are also figured for all 146 species, and pupae of most of them are also shown. Most of the species and a fair number of the genera are previously undescribed in the larval stage, and several are essentially new at supra-generic levels, such as the leiodid *Scotocryptodes*, the scarabaeoid *Cryptogenius*, the artematopid *Artematopus*, the elateroid *Lissomus*, the phengodid *Phrixothrix*, the cisid *Porculus*, the cerambycid *Migdolus* and the platypodid *Tesserocerus*. The best represented families are Scarabaeidae, Elateridae and Tenebrionidae, and the book should be of particular interest to specialists in these groups. The authors do not make detailed comparisons between larvae described by them and related ones known previously, but their figures are generally good enough to make it possible for others to do so. Nearly all the larvae dealt with have been reared, and useful data are given on their habitats and habits.

It is notable that the *Scotocryptodes* larva resembles known ones of Leiodinae rather than of Catopinae, that the *Artematopus* larva differs from that of *Eurypogon* in many features of the head and is described as being predaceous rather than moss-eating, that the *Lissomus* larva resembles previously-known ones of Oestodinae rather than of Throscidae, that the *Phrixothrix* larva resembles unnamed phengodid larvae from Malaya seen by me where it differs from *Phengodes*, that the *Lemphus* (Malachiinae) larva is notably similar to Australian ones attributed to Carphurini, and that the *Tesserocerus* larva lacks the prothoracic peculiarities of *Platypus*. The excellent figures of a *Migdolus* larva make it clear that its group (Anoploderminae) is not truly cerambycid and is not related, as formerly proposed by me, to Parandrinae. A notable feature it shares with the European *Vesperus*, but not with any other described larvae within Chrysomeloidea, is the long 3-segmented antennae.

The entire text of the book is in Portuguese, a language so close to Spanish that it should be largely intelligible to anyone with a working knowledge of that tongue. The publication of a work of this character could hardly be justified if its circulation were limited to Coleoptera larval specialists who know Spanish or Portuguese. The pictures alone should ensure this book a place in serious entomological libraries throughout the world, and in the personal libraries of serious students of larval Coleoptera everywhere.

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DESCRIPTION OF MATURE LARVAE OF *LEPESOMA BAKERI* (VAN DYKE) (COLEOPTERA: CURCULIONIDAE)[1]

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ABSTRACT

A description of mature larvae of the weevil *Lepesoma bakeri* (Van Dyke) is presented with illustrations.

Mature larvae of *Lepesoma bakeri* (Van Dyke) were collected among severely injured roots of cranberry, *Vaccinium macrocarpon* Aiton, in commercial fields near Bandon, Oregon, in association with numerous adult weevils of that species. The collection was made April 27, 1986 by Dr. Glenn C. Fisher, Oregon State University Extension Service. No other insects injurious to roots were present. Collected adults were determined by C. W. O'Brien, Florida Agricultural and Mechanical University.

Mature larvae of *Lepesoma bakeri* (Van Dyke)

Average size and range of 10 mature larvae: body length 7.9 mm (range 6.8–9.0 mm); width 2.8 mm (range 2.3–3.0 mm); head width 1.5 mm (range 1.4–1.7 mm). Body pale cream colored with free light brown head.

Head with ventral end of each paraepicranial suture band diverging slightly laterally (Fig. 1). Occipital vittae broad, contrasting pale cream, extending from frontal seta 4 through dorsal epicranial seta 1 with outer margin slightly indented. Parietal areas tan. Each mandible with dark brown outer edges and tip, unworn tip bifid. Scrobiculum round, pale and very near upper dark brown mandibular margin. Mandibular seta 1 three times length of 2. Clypeal ridge with slightly indented, straight clypeal groove. Labral setae 2–2 separated by twice distance between 1–2. Ligula with sensory organ slightly distad horizontally from ligular seta 1 (Fig. 2). Dark maculae of hypopharyngeal bracon tricornered and located one-third length of hypopharyngeal bracon from ends (Fig. 4). Epipharynx with 5 anterolateral setae with number 1 apically curved inward (Fig. 3). Two adjoining distal sensillae posterior to anterior median seta 2, midway between median epipharyngeal seta 3 and anterolateral epipharyngeal seta 1. Labral rods capitate, caudal end tapering to point. Median setae 2 of epipharynx slightly distad from line through setae 1–3. Sensillum cluster just distal to line between median setae 1–3 and equidistant from them.

Pronotum uniformly pale cream with shiny minutely dimpled surface (Fig. 5). Pronotal setae 1–2 separated by three times distance between 2–3. Pronotal seta 9 is 0.4 as long as 6. Arrangement of post dorsal setae on second thoracic segment 11|1 and 1-1|1 on third segment (Fig. 6). Dorsolateral area with 2 setae. Epipleuron of second thoracic segment diagonally divided with 2 setae at elevation of thoracic spiracle plus one microseta before and above elevation of epipleural seta 1. Epipleuron of third thoracic segment diagonally divided with 2 upper epipleural setae. Venter of thorax with pedal area seta "z" present just lateral to line between seta "x"–"y" (Fig. 9). Anterosternal

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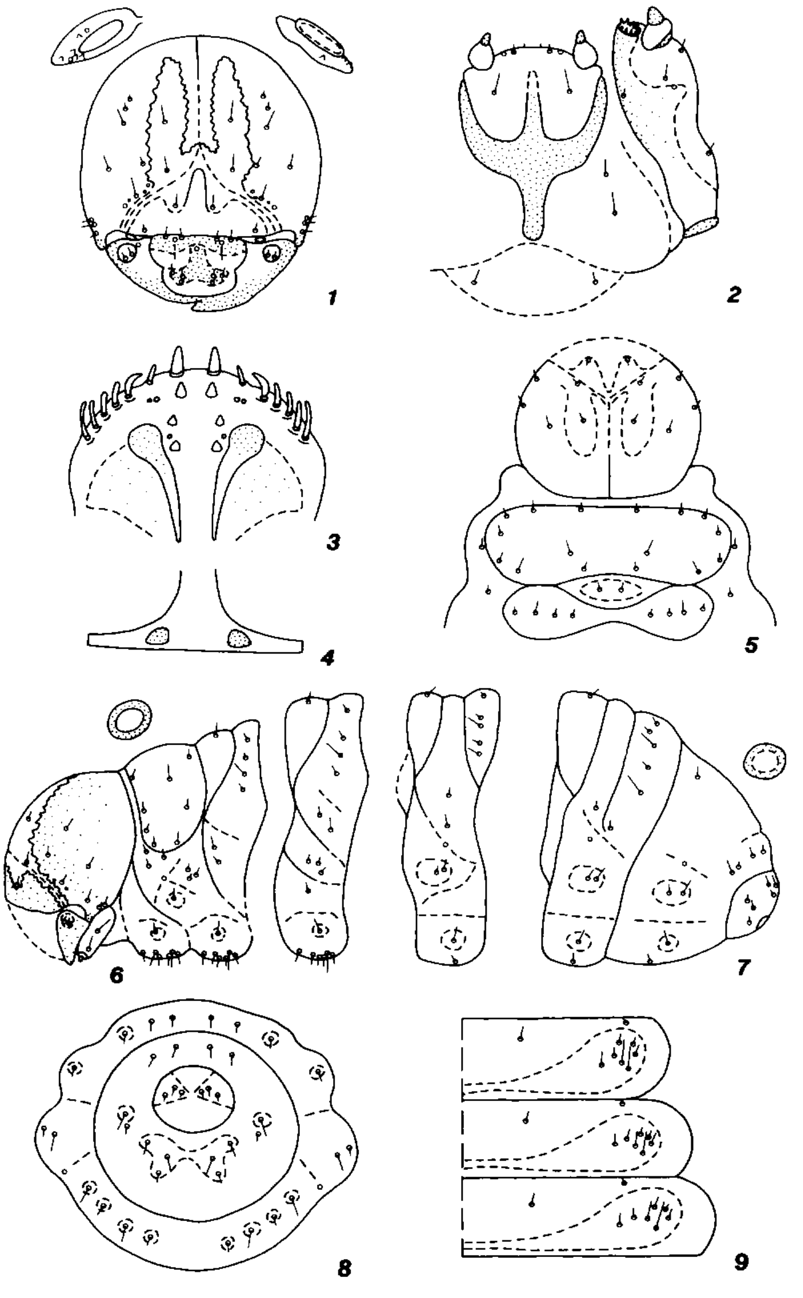
[1] This paper has been identified as Technical Paper No. 8502 of the Oregon State University Agricultural Experiment Station, Corvallis, OR 97331-2907, which I appreciate.



Figs. 1–9. *Lepesoma bakeri* (Van Dyke). 1, head, front view, antenna enlarged. 2, labium and left maxilla. 3, epipharynx. 4, hypopharyngeal bracon and maculae. 5, cranium vertex, pro- and mesothorax, dorsal view. 6, head and thorax, lateral view, spiracle enlarged, metathorax detached. 7, abdominal parts, lateral view, A2 detached and A3–6 omitted, spiracle enlarged. 8, abdomen, caudal. 9, left pedal lobes (diagrammatic).

microseta present on all ventral thoracic segments. Line through pedal setae "t"–"u" would intersect line through "v"–"w" at angle of 110° on second segment.

Abdomen with post dorsal setae arranged ʜHl on segment 1, ʜHl on segments 6 and 7 (Fig. 7) and ıHl on segment 8. On segment 9, post dorsal setae ılı in elongate triangular arrangement on each side in caudal view (Fig. 8) with seta 3 laterad of 1 by distance separating 1–2. All segment 9 post dorsal setae in single, connected, asperity-free area. Inner point of dorsal segment of segment 9 at angle of 175° with sides.

In the key to some species of *Lepesoma* of Rosenstiel (1987) *L. bakeri* falls just before couplet 3(6) as its post dorsal seta 2 of the eighth abdominal segment is not closer to seta 1 than to 3 (Fig. 8) and post dorsal seta 2 of the seventh abdominal segment is not in line (Fig. 7). *Lepesoma bakeri* differs from the other described species in the key by the confluent, asperity-free condition of the post dorsal setae 1–2–3 on adjoining sides of the ninth abdominal segment (Fig. 8).

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BOOK REVIEW

COSTA, C., S. A. VANIN, E S. A. CASARI-CHEN. 1988. **Larvas de Coleoptera do Brasil.** Universidade de São Paulo, São Paulo. v + 282 p., 165 plates. US$65.00.

The last several years have shown a marked increase in the number and quality of works dealing specifically with the immatures of insects, including Coleoptera. Fortunately, this work has come in spite of the relative paucity of workers actively conducting systematic research and publishing on insect immatures. However, most of this work has involved the better known faunas of North America and Eurasia. Thus, it is quite notable that not only has a book been published providing much needed descriptive and bionomic data on beetle immatures, but also that it covers the fauna of central South America. This large and ecologically important region has long lacked enough resident attention to the systematics of its insect fauna. Because the Brasilian insect fauna is so large, our knowledge so little, and our specialist colleagues so few, a synthesis of available material and data is most welcome. With the immense challenge and need of study on immature beetles, the authors can do little more than provide a basis and inspiration for further study. They have provided this base in their contribution by illustrating our ignorance and the challenge of studying immature insects, in the Neotropics and elsewhere.

Preliminary chapters involving the first 26 pages include materials and techniques, a general discussion of metamorphosis concentrating on the larval and pupal stages, ecology, morphology (with in-text drawings), and an updated classification scheme and listing of the Brasilian beetle families. Next follows a long, 278-couplet key to the families. This key makes no pretense of phyletic relationships and is designed solely for identification purposes. Consequently, many families are typically reached through two or more routes. For those not prepossessed with an uncontrollable desire for dissection of mouthparts, couplets requiring dissection are generally not met with until absolutely necessary.

The bulk of the book (almost 200 pages) is devoted to detailed descriptions of the 109 families currently recorded from Brasil. Descriptions, life history notes, and references are provided for each suborder and family, with numbers of species for World and Brasilian taxa. If larvae and pupae of any Brasilian genera and species are known, descriptions of each are included and each has bionomic, distribution, and specimen repository information included. Although many of the included taxa were described previously in journal articles, and much of this work by these authors, there are a large number of larvae and pupae described for the first time.

Only a 7-page list of cited references is included, but this list appears to include the primary taxonomic, bionomic, and morphological literature, in general and for the families treated. A glossary and taxonomic index complete the text.

The last section of the book includes 146 full-page plates of excellent habitus line drawings of larvae, pupae and adults, as well as salient features including mouthparts, headcapsules, legs, and spiracles. The quality and rendering of the artwork are consistent throughout. These illustrations are followed by 19 plates of black-and-white photographs of selected taxa, although there is a definite bias toward luminescent larvae and pupae. Unfortunately, some of these plates lack the clean, well-organized aspect of the drawings and other plates, and some of the photographs appear faded and somewhat out-of-focus. This is the greatest fault of the book, however.

Generally the typesetting and editing appear to be of good quality, with only occasional, minor misspellings. Those most evident are "Hidroscaphidae" for Hydroscaphidae on page 69, and "Burakowiski" for Burakowski on pages 141 and 154. The book has been published in a 21 × 28.5 cm format, and the printing is dark and clean on high quality paper. Although published in Portuguese, with rather minimal use of a Portuguese-English dictionary I have found relatively little difficulty in interpreting the well-written text.

The authors should be highly commended for producing such a well constructed, high quality reference for those interested in beetle larvae.

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BEETLES (COLEOPTERA) OF AN OIL-BIRD CAVE: CUEVA DEL GUÁCHARO, VENEZUELA

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Abstract

A community of 29 species of scavenging, seed-feeding, and predacious beetles is supported by the oil bird in Cueva del Guácharo, Venezuela. We report 21 species as new for this cave.

Many studies of cave-dwelling faunas have listed the beetles supported by bats and their guano. However, we know of no published summary of this fauna. Besides bats, South America contains another unique cave-dwelling vertebrate which also supports an insect community. This is *Steatornis caripenis* Humboldt, the oil bird or guácharo, known to nest only in caves in Trinidad, Venezuela, Colombia, Ecuador, and Peru. These birds feed at night on fruits and seeds in nearby forests and return to the cave roosts to feed their young. Then both adult and young birds regurgitate the undigestible seeds. Large quantities of regurgitated matter, bird droppings, and bird carcasses, all collectively termed "guano," accumulate under roosts in oil bird caves (Fig. 1) (Snow 1961, 1962). The insect faunas of these accumulations have not been well documented for any cave. The purpose of this paper is to report on the beetle fauna of an oil bird cave, in the hopes that other guácharo caves will be studied for comparison.

Cueva del Guácharo, the most famous cave in South America, is located at about 1,000 m elevation, near the town of Caripe, in Monagas state, northeastern Venezuela. The cave, its fauna, and nearby forest are protected in El Guácharo National Park. Some 1,000 m of cave and the oil birds are shown daily, and it is one of the finest nature experiences available to tourists in Latin America. Another 9 km of cave are present, but are difficult to enter and do not contain oil birds. Guácharo caves typically have very large entrances and the rotting seed piles would be expected to contain a varied beetle fauna drawn from the surrounding forests (Fig. 2).

Eight beetle species have been reported from the cave (Decú *et al.* 1987), and we report the presence of another 21 species. Collections have been made here over a span of years by many entomologists. Our collections date from 3 days in August 1987 and were made in the dark zone of the cave by hand and by Tulgren funnel extraction of 15 kg of oil bird droppings and seed piles.

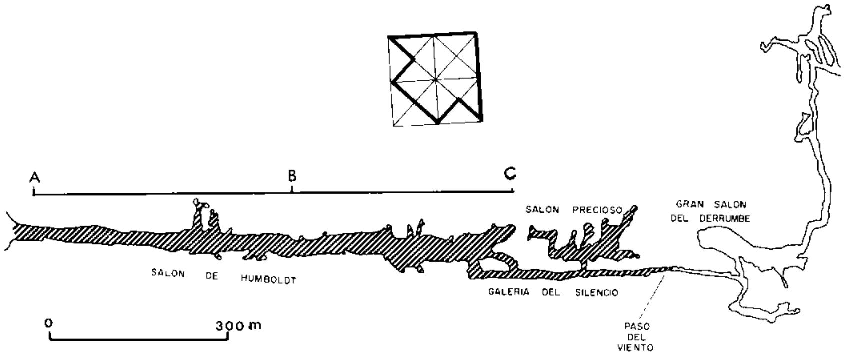

Fig. 1. Map of Cueva del Guácharo. Darkened area is the tourist section. From A to B, the Guácharo population is very dense; from B to C exist only isolated individuals. The Galley of Silence and beyond has no oil birds because the passageways are too narrow for them to navigate, using their echolocation abilities.

Specimens are deposited in the collections of the authors, the Canadian National Collection, and the Facultad de Agronomia, Universidad Central de Venezuela, Maracay.

Faunal List

Carabidae, Agonini

Colpodes near *cyanipennis* Chaudoir. This is the most conspicuous beetle in the cave. It is an abundant predator, actively foraging freely over guano covered rocks, mud banks, and the tourist trail. It probably feeds on young gryllid crickets.

Carabidae, Masoreini

Masoreus sp. Found in very wet guano along the cave stream. It possibly feeds on oligochaetes.

Carabidae, Bembidiini

Paratachys sp. Found abundantly on wet mud flats along the cave stream and on moist mud slopes under protective overhangs of large rocks. These probably feed on small oligochaetes. The genus contains hundreds of Neotropical species.

Carabidae, Pterostichini

Pseudabarys robusta Bates. This Brazilian species was reported in the cave by Decú *et al.* (1987).

Hydrophilidae, Sphaeridiinae

Oosternum costatum Sharp. This scavenging species is common in very wet guano under water drips or at the edge of the stream. It is widely distributed from Venezuela through the West Indies and Central America to the central United States (Smetana 1978).

Leiodidae, Cholevinae

Adelopsis brunneus linaresi Szymczakowski (1975). This species occurs in various caves in Trinidad and Venezuela and this subspecies is an

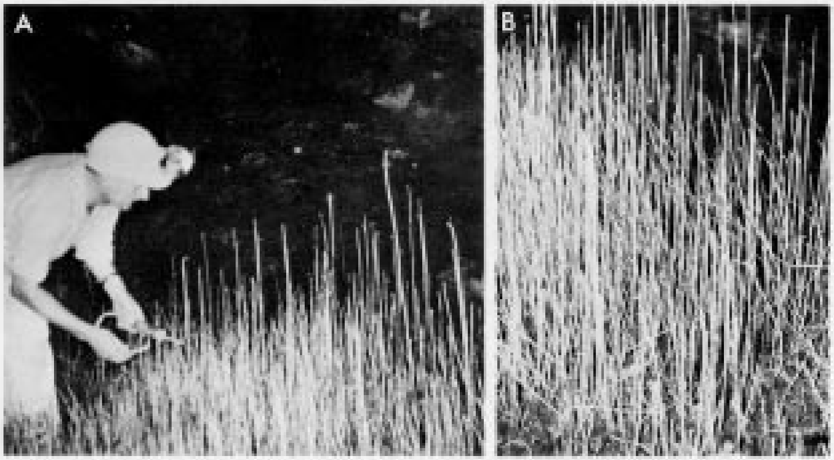

Fig. 2. A. Mass of plant material accumulated under an oil bird roost. The regurgitated seeds sprout where there is sufficient moisture. B. When their stored food reserves are exhausted, the seedlings die in the perpetual dark of the cave. Crickets and true bugs feed on the etiolated seedlings, but we saw no evidence of beetles feeding on them. Photographs by C. Bordón.

endemic to the cave. It is found only infrequently in small moist (not wet) depressions which catch a small sprinkling of guano. It probably feeds on fungi or bacteria growing on guano.

Leiodidae, Bathysciinae

Neotropospeonella decui Pace (1983*a*, 1987). This remarkable, eyeless, scavenging beetle is known from only two females. The subfamily is otherwise only Holarctic in distribution. Most of the species are cave-restricted in Europe.

Staphylinidae, Xantholininae

Neohypnus sp. Very abundant in the seed piles.

Staphylinidae, Aleocharinae

Troglocyphodas decui Pace (1984). Less frequently found (14 specimens) in seed piles, and known only from this cave.

Staphylinidae, Aleocharinae, Oxypodini

Meoticaops sp. Four specimens of an undescribed species from seed piles. The genus is otherwise known only from *M. franzi* from 4,160 m in the Andes, near Merida, Venezuela (Pace 1983*b*).

Staphylinidae, Aleocharinae, Calicerini

Atheta sp. One specimen from seed piles.

Staphylinidae, Lispinae

Aneucamptus crassus (Sharp). Infrequently found in seed piles. The species is known from Mexico to Bolivia and Brazil (Irmler 1985).

Pselaphidae

Trimiopsis claviceps Reitter. Infrequently found predator in seed piles (Bordon leg.).

Scydmaenidae

Homoconnus bordoni Franz (1986). Infrequently found predator in seed piles, where it preys on mites or Collembola. The species is also known from several non-cave sites in Venezuela.

Scydmaenus sp. Infrequently found predator in seed piles, where it preys on mites or Collembola.

Histeridae, Tribalinae

Epierus sp? A frequent predator in the seed piles.

Histeridae, Saprininae

Genus B. A frequent predator in the seed piles.

Genus C. A frequent predator in the seed piles.

Histeridae, Dendrophilinae

Bacanius sp? An uncommon predator in the seed piles.

Paromalus infimus Marseul. Frequently found in extraction of material from seed piles (Bordon leg.).

Scarabaeidae, Hyboscerinae

Anaides cf. *fossulata* Westwood. Common in seed piles, where it feeds on decaying plant matter.

Nitidulidae

Stelidota guacharensis Gillogly (1962). The species is known only from this cave, and from presumed epigean sites at Caripe and Caracas, Venezuela (Gillogly 1962). It is a very abundant scavenger on fresh seed piles.

Lathridiidae

Holoparamecus (*Calyptobides*) *dispar* Belon (?). This is a common scavenger in the seed piles. It is distributed from Venezuela to Brazil.

Biphyllidae

Gonicoelus sp. A. This is a common scavenger in the seed piles. The family seems to be unreported for Venezuela. The species occur in fermenting situations, and may feed on ascomycete spores.

Gonicoelus sp. B. This is a common scavenger in the seed piles.

Tenebrionidae, Ulomini

Phayllus ojastii Kulzer (1961). This species is known only from this cave, where it is a common scavenger in the seed piles.

Scolytidae

Pagiocerus frontalis (Fabricius). This species is widely established from North Carolina to Argentina. It feeds on the seeds of large trees, and is often a pest of stored corn in South America (Wood 1982). It is common in the seed piles, which it uses for reproduction. It has also been recorded from Cueva Coy Coy de Uria, Falcon State, Venezuela (Decú *et al.* 1987).

Coccotrypes carpophagus (Hornung). The species, probably originating in Africa (Wood 1977), is now cosmopolitan through commerce. It is common in the seed piles, which it uses for reproduction. This species, under the name *Coccotrypes dactyliperda* Fabricius, with reduced eyes, has been reported from the Oropouche oil bird cave in Trinidad (Bright 1981). Only females were collected and the population is probably parthenogenetic.

Curculionidae, Molytinae (= Hylobiinae)

Marshallius sp. Regularly but infrequently found walking on the sides of large rocks. The larvae probably feed in the seed piles.

CONCLUSIONS

Only one beetle species is known to be an eyeless and cave limited species (troglobite). All the rest can be called troglophiles, and may also be found in dark and moist non-cave habitats. The decaying bird droppings, regurgitated seeds, and bird carcasses support a large and varied fauna of 12 species of phytophagous or scavenging beetles, as well as mites, Collembola, etc. These support a fauna of 17 species of predator beetles. The fauna seems to be not significantly different from that which would be found under a large cave roost of Neotropical fruit bats. Further comparative studies are encouraged.

ACKNOWLEDGMENTS

We thank President German Romero Gonzales, Instituto Nacional de Parques, Ministerio del Ambiente, for permission to study insects in Venezuelan National Parks. Determinations were made with the help of D. E. Bright, Y. Bousquet, J. M. Campbell, J. Klimaszewski, G. Müller, H. F. and Anne Howden, J. F. Lawrence, O. Park, A. Smetana, and R. W. Wenzel. Field work was made possible by operating grants from the Natural Sciences and Engineering Research Council of Canada.

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SCIENTIFIC NOTE

DISTRIBUTION OF *PENTAGONICA FELIX* BELL (COLEOPTERA: CARABIDAE) IN MEXICO

The ground beetle *Pentagonica felix* was described from Arizona and New Mexico (Bell 1987). Recently, through the courtesy of Dr. Yves Bousquet, Biosystematics Research Centre, Ottawa, Canada, I have been privileged to study additional specimens from both northern and southern Mexico. One male and one female are labelled "24 mi. W. La Ciudad, Dgo., Mex., VI-15-64, H.F. Howden." An additional male is labelled "8 mi. E. San Cristobal d.l.C., Chis., 17-V-69, J.E.H. Martin." Since this extends its range to Durango and Chiapas, it might also be expected throughout Mexico. It can be recognized by the large size, 5.0–5.9 mm; the elytra less truncate than in other species; and the distinctive color pattern, with head, pronotum, antennal segments 5–11 dark, elytral intervals 1–4 dark except at the apex, and remainder of the body including outer elytral intervals pale. In most specimens, there is an oblique dark mark of varying extent in the region of the outer apical angle of the elytron.

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REVISION OF THE *CHIMBU* GROUP OF *SCOPODES* (COLEOPTERA: CARABIDAE)

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ABSTRACT

Scopodes chimbu Darlington and *S. tafa* Darlington are here placed in the *chimbu* group. An additional species, *Scopodes wei,* new species, is described and illustrated. A key and amplified descriptions of the two Darlington species are provided.

Scopodes Erichson is a small genus of Pentagonicini found in Australia, New Guinea, New Zealand, New Caledonia and Java. In superficial appearance, adults are quite unlike those of the nearly cosmopolitan *Pentagonica* Schmidt-Goebel, suggesting rather *Elaphrus* Fabricius because of the huge eyes, relatively narrow prothorax, metallic coloring, complex surface sculpture and largely diurnal habits. The elongate and clavate ligula of the labium separates adults of this genus from those of the sympatric and similar *Parascopodes* Darlington.

Darlington (1968) described two species of *Scopodes* from the mountains of New Guinea, which differ from other known members of the genus in having the elytral microsculpture conspicuously irregular, with contrasting shining and dull areas, much as in some species of *Elaphrus* and *Bembidion.* In 1982, we collected additional specimens of *Scopodes chimbu* Darlington and *S. tafa* Darlington, along with many specimens of a third, undescribed species. Adults of all three species are diurnal, found running on disturbed soil. Most of our specimens are from Mount Kaindi, south of Wau, Morobe Province, Papua New Guinea. The top of this mountain is much disturbed by diggings and paths resulting from gold prospecting, a situation apparently favoring these beetles. A few specimens came from nearby Mount Missim. One of these was caught at the edge of a large landslide, possibly the original natural habitat for this species group.

Members of the *chimbu* group have the following characters in common. Elytral microsculpture forming contrasting shining and duller areas caused by alignment of microsculpture in various directions, so that a given area may appear either light or dark, according to the angle of the incident light. Labrum rounded, with six setae; clypeus, frons with longitudinal carinae, approximately seven of them at level of middle of eye. Pronotum cordate, convex, strongly narrowed posteriorly; conspicuously, transversely rugulose; lateral seta of pronotum on projecting tooth; posterior lateral seta absent. Elytra with striation weak, somewhat irregular; humerus rounded, with very short setae along margin; lateral margin sinuate just anterior to middle; apex of each elytron obliquely truncate to shallowly sinuate; third interval with three discal setae in large foveae, these form line with ocellate seta at base of elytron and apical seta; marginal setae in four groups as follows—five posthumerals, one intermediate, three postmedials, and usually four posteriors, the latter group just anterior to outer apical angle of elytron. Left paramere much smaller than right one.

KEY TO SPECIES OF *CHIMBU* GROUP OF *SCOPODES*

1. Discal foveae of elytron blue, contrasting with green or bronze of elytral disc; marginal tooth of pronotum relatively large; apical lobe of penis pointed, scarcely differentiated by constriction (Fig. 4); apical segment of female gonocoxite with two short, blunt ensiform setae laterally; medial seta apparently absent (Fig. 7) .... *Scopodes tafa* Darlington

1′. Discal foveae not contrasting with elytral disc; marginal tooth of pronotum relatively small; apical lobe of penis differentiated by constriction; apical segment of female gonocoxite with two long, acute ensiform setae laterally; one medial seta present 2

2(1). Legs pale with dark tarsi; sutural interval of elytron conspicuously shining; apical lobe of penis very long, asymmetrical (Fig. 2); medial seta of apical segment of female gonocoxite ensiform, medial seta of basal segment subensiform (Fig. 5) .... *Scopodes wei* Bell and Bell, new species

2′. Legs dark, tibiae, trochanters brown, remaining segments black; sutural interval not conspicuously shining; apical lobe of penis shorter, less asymmetrical (Fig. 3); medial setae of female gonocoxite segments slender, not at all ensiform (Fig. 6) .... *Scopodes chimbu* Darlington

Scopodes tafa Darlington 1968

DESCRIPTION. Length 3.2–4.2 mm. Dorsal surface largely metallic bronzed green; head, pronotum tinged with bluish-purple in some specimens; dorsal foveae in contrasting bright metallic blue spots, similar but less discrete spots around marginal setae; antennal segments 1–4 pale; 5–10 dark brown; legs pale, tarsi darker, but not as contrasted to tibia as in *S. wei.*

Pronotum with lateral tooth relatively big, its transverse dimension nearly width of antennal segment 4; elytron shallowly sinuate apically; elytral microsculpture of three kinds—in blue areas and near scutellum isodiametric or nearly so, in shining areas lateral to foveae longitudinally meshed, in areas between foveae mostly transverse meshes (these areas appear as light and dark contrasting areas, lighter if meshes are transverse to light source, darker if longitudinal to it).

Apical lobe of penis (Fig. 4) pointed, scarcely constricted in dorsal view; in lateral view, apex long, tapered, sinuate. Female gonocoxite (Fig. 7) with medial seta on basal segment, apparently without medial seta on apical segment, but with two short, blunt ensiform lateral setae.

This is the rarest of the three species in our collection. We have five specimens from Mount Kaindi (March 8 or 17, 1982), and one from Mount Missim (April 2–3, 1982). Darlington (1968) recorded this species from Mount Tafa, and from Bulldog Road, south of Wau, as well as from the type locality, Mt. Tafa. The type is in British Museum of Natural History. We have studied paratypes in Museum of Comparative Zoology.

Scopodes chimbu Darlington 1968

DESCRIPTION. Length 3.5–4.9 mm (length given by Darlington 3.5–4.4; our specimens range from 3.9–4.9, averaging about 4.6). Dorsal surface metallic, either greenish bronzed with golden or coppery tints, or dark blue-green to blue-violet [color morphs largely distinct, with few specimens somewhat intermediate; of 73 specimens, 41 dark blue-green, 32 bronzed or coppery green]; in bronzed phase, dorsal punctures of elytra bluish

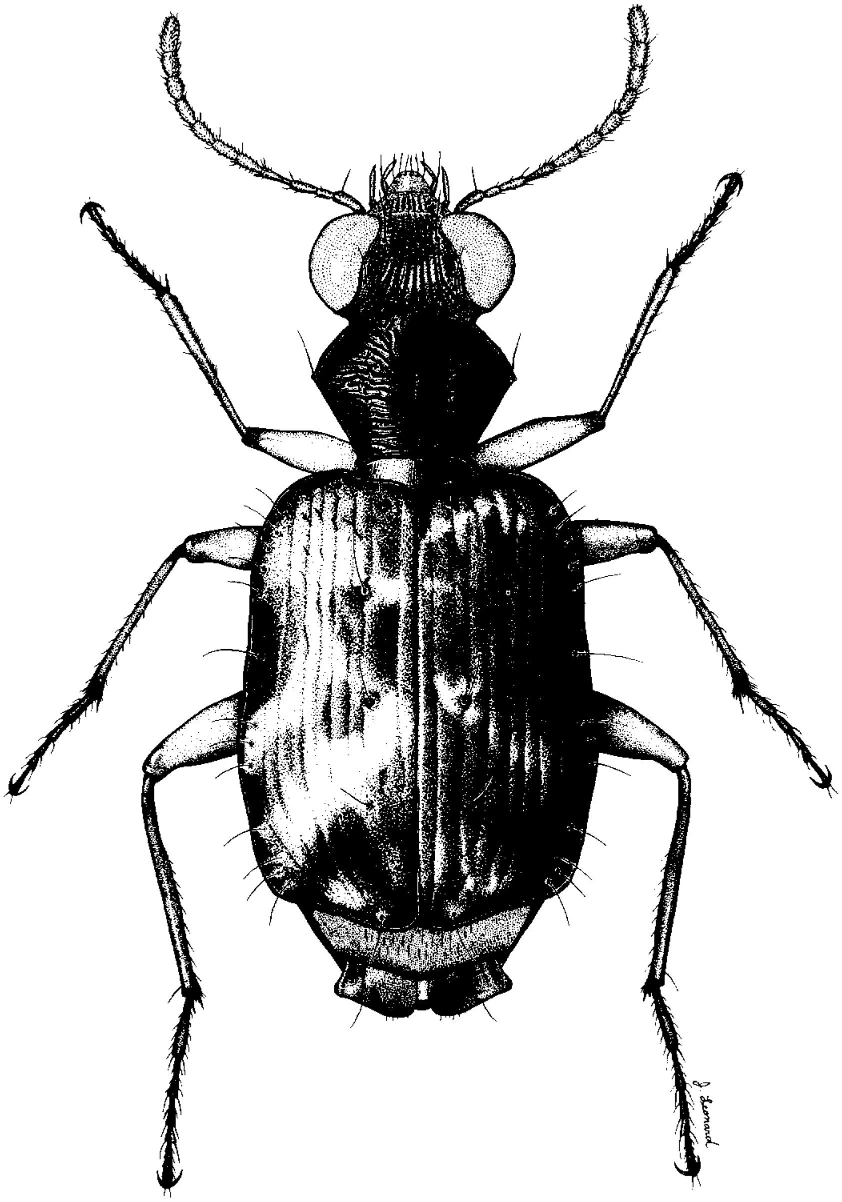
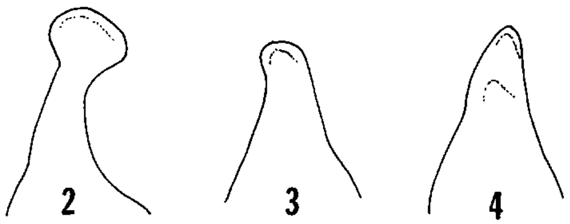
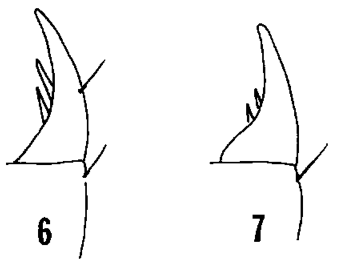


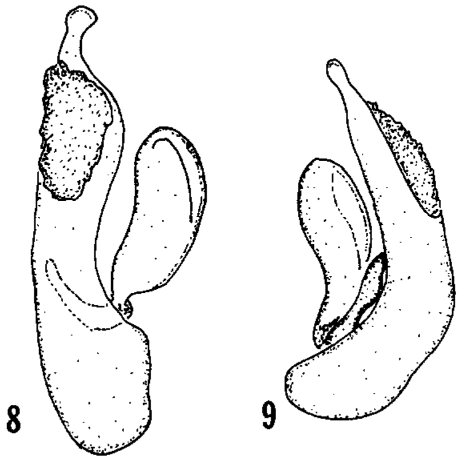
Fig. 1. *Scopodes wei* Bell and Bell, dorsal habitus, scale equals 1 mm.

(but not surrounded by enlarged bluish area, as in *tafa*); in blue phase, dorsal punctures not contrasting; antennal segments 1–4 pale brown, partly darkened dorsally; outer segments piceous; legs largely black, but trochanters, tibiae dark brown.

Pronotum with lateral tooth relatively small, its transverse dimension clearly less







Figs. 2–4. *Scopodes* spp., apex of penis in dorsal view. 2, *S. wei* Bell and Bell. 3, *S. chimbu* Darlington. 4, *S. tafa* Darlington.

Figs. 5–7. *Scopodes* spp., apex of left female gonocoxite in posterior view. 5, *S. wei.* 6, *S. chimbu.* 7, *S. tafa.*

Figs. 8, 9. *Scopodes wei,* male genitalia. 8, dorsolateral view. 9, lateral view.

than width of antennal segment 4; elytra relatively long, narrow, apex of each elytron not sinuate.

Apical lobe of penis (Fig. 3) constricted, relatively short, with sides nearly parallel; in lateral view, apical lobe relatively short, straight. Female gonocoxite (Fig. 6) with medial seta on each segment not ensiform; apical segment with two long, acute ensiform setae.

This was the commonest species on Mount Kaindi where we collected 71 specimens (March 8–April 6, 1982). We also collected two specimens on Mount Missim (March 26, April 3, 1982). Darlington (1968) lists many other localities, including the type locality, the Chimbu Valley in the Bismarck Range. We have studied the type, in the Museum of Comparative Zoology collection.

Scopodes wei Bell and Bell, **new species**

Type Material. HOLOTYPE, male, labelled "PAPUA NEW GUINEA, Wau, Mt. Kaindi, 2,300 m, March 17, 1982, coll. R. & J. Bell." To be deposited in Carnegie Museum of Natural History. PARATYPES, 40 males, 35 females, same label as holotype; six males, one female; same locality, but dated March 8, 1982; three males, one female, same locality, but dated April 6, 1982.

Paratypes will be distributed to the Carnegie Museum (Pittsburgh), the U.S. National Museum of Natural History (Washington), the Museum of Comparative Zoology (Cambridge), the Canadian National Insect Collection (Biosystematics Research Centre, Ottawa), the British Museum of Natural History (London), Museum National d'Histoire Naturelle (Paris), the Bernice P. Bishop Museum (Honolulu), the Australian National Insect Collection (Canberra), and the University of Vermont.

Description. Length 4.0–5.0 mm; habitus (Fig. 1); with characters of *chimbu* group, as defined above. Dorsal surface metallic, most commonly elytra green with contrasting coppery sutural interval, pronotum coppery or green tinged with copper or purple, head frequently greener than pronotum; some specimens entirely coppery bronzed; one specimen blue-green with diffuse purple areas on both elytra and pronotum; in all specimens, sutural interval contrasts in brightness and to some degree in color with remainder of elytron; exposed abdominal tergum piceous; hidden thoracic and abdominal terga (beneath elytra) bright metallic blue; antennal segments 1–4 pale, outer segments successively slightly darker; legs largely pale; but knee joints and tarsi contrastingly dark.

Outer antennal segments less abruptly widened than in *S. chimbu.* Lateral tooth of pronotum proportionally small, its transverse dimension less than width of antennal segment 4. Elytra wider than in *S. chimbu,* elytral apex oblique to shallowly sinuate.

Apical lobe of penis (Figs. 2, 8, 9) relatively elongate, curved, with spatulate tip. Female gonocoxite (Fig. 5) with two long, acute, ensiform setae on lateral margin of apical segment; medial margin of apical segment with one similar ensiform seta; medial seta of proximal segment stouter than in *S. chimbu,* subensiform.

The specific name "wei" is formed from the acronym for the Wau Ecological Institute.

Acknowledgments

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COPULATION *IN NATURA* OF PASSALID BEETLES (COLEOPTERA: PASSALIDAE)[1]

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Some 500 species of passalid beetles are known, showing mostly an intertropical distribution (Reyes-Castillo 1970). Despite this large number, copulation has only been observed in 14 New World species (Table 1). First recorded by Schuster and Schuster (1971) in some Peruvian species, copulation in Passalidae shows characteristic features described in detail by Schuster (1975) and by Valenzuela-González and Castillo (1983, 1984). The venter to venter position of male and female during copulation is the most striking feature, and is considered as an adaptation to the narrow galleries where copulation takes place. The total number of copulation bouts observed in the 14 species of Table 1 is 30 plus three cases in which the male exerted the aedeagus but did not copulate. In these 33 cases, the observations were made on couples in captivity, usually inside Petri dishes and during variable lapses of time. The abovementioned authors, as well as those that have described different aspects of the subsocial behavior in these beetles (Ohaus 1900; Reyes-Castillo and Halffter 1983, 1984), assumed that copulation took place in the galleries that the founding couple built within rotten logs where they nest.

Undoubtedly, copulation is difficult to observe even with couples under captivity and, to date, has not been recorded in nature. Perhaps this difficulty is related to the complex courtship process that involves a series of behavioral bouts that must not be interrupted. Apparently, these bouts occur only for a short period of time in which male and female must be synchronous, something difficult to obtain under laboratory conditions.

On July 29, 1985, at Los Tuxtlas, Veracruz (México), in a coffee plantation near the town of Dos Amates (elevation 395 m), we opened a rotten log and discovered a gallery with a couple of *Passalus* (*Pertinax*) *punctatostriatus* Percheron in copulation. The position (Fig. 1) was the typical one described for Passalidae (see Schuster 1975). The log, highly decomposed, was *Spondias rodlkoberii* Donn. Sm. (Anacardiaceae), which is known locally as "jobo." It was about 2 m long and 40 cm in diameter. Besides the copulating pair, two pairs of the same species were found in the same log plus one adult of *Verres cavicollis* Bates in a short colonization gallery. This finding confirms the opinion of several authors that copulation in Passalidae takes place within the galleries excavated by the founding couple.

Passalus punctatostriatus is the most abundant passalid of the 14 that have been recorded at Los Tuxtlas; it is found in several vegetation types, from sea level to 800 m, both in evergreen tropical forests and cloud forests, and in secondary forests and abandoned grasslands on different stages of secondary succession. The degree of decomposition and the size of the logs where this

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Fig. 1. *Passalus* (*Pertinax*) *punctatostriatus* Percheron, *in natura* copulation. Los Tuxtlas, Veracruz, México. Photo by M. L. Castillo.

Table 1. Copulation in Passalidae: species in captivity.

Species	Number of events observed	Country
PASSALINI		
1. *Passalus* (*Pertinax*) *affinis* Percheron	4[b]	Dominican Republic
2. *Passalus* (*Pertinax*) *convexus* Dalman	1[b]	Peru
3. *Passalus* (*Pertinax*) *inops* Truqui	e[d]	Mexico
4. *Passalus* (*Pertinax*) *punctatostriatus* Percheron	e, 1[d]	Mexico
5. *Passalus* (*Passalus*) *coniferus* Eschscholtz	1[a]	Peru
6. *Passalus* (*Passalus*) *punctiger* Lep. et Serv.	6[b]	Mexico
7. *Passalus* (*Passalus*) sp. III	3[a]	Peru
8. *Ptichopus angulatus* (Percheron)	e[d]	Mexico
PROCULINI		
9. *Oileus heros* (Truqui)	1[d]	Mexico
10. *Odontotaenius disjunctus* (Illiger)	4[a]	U.S.A.
11. *Odontotaenius striatopunctatus* (Percheron)	1[a]	Mexico
12. *Odontotaenius zodiacus* (Truqui)	2[b,d]	Mexico
13. *Heliscus tropicus* (Percheron)	5[c]	Mexico
14. *Verres corticicola* (Truqui)	1[d]	Mexico

[a] Schuster and Schuster (1971).

[b] Schuster (1975).

[c] Valenzuela-González and Castillo (1984).

[d] Authors' observation.

[e] Non-copulating male with exerted aedeagus.

species is found vary widely; it can be found in logs of 1 to 26 m in length and 10 to 120 cm in diameter, under the bark, in the duramen or even under the trunk. During a period of field work of 41 days distributed in 16 months, 20 lone specimens, 16 founding couples and 66 familial groups have been found, these last formed by the founding couple, immature stages (eggs, larvae and pupae) and/or teneral adults of the first generation. The passalid beetles that are most frequently found in the same logs as *P. punctatostriatus* are: *P.* (*Passalus*) *punctiger* Lep. and Serv., *P.* (*Pertinax*) *caelatus* Erich., *Paxillus leachi* MacLeay, *Odontotaenius striatopunctatus* (Percheron), *Verres corticicola* (Truqui), *V. cavicollis* Bates, *Heliscus tropicus* (Percheron) and *Veturius* sp.

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CRYPTOGAM HERBIVORY IN CURCULIONIDAE (COLEOPTERA) FROM THE SUB-ANTARCTIC PRINCE EDWARD ISLANDS

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ABSTRACT

Six weevil species belonging to the tribe Ectemnorhinini are found on the Prince Edward Islands (46°54'S, 37°45'E). With the exception of *Dusmoecetes similis* (C. O. Waterhouse), which feeds on angiosperms, all the species, *viz. Palirhoeus eatoni* (C. O. Waterhouse), *Bothrometopus randi* Jeannel, *Antarctonesiotes elongatus* Jeannel, *Mesembriorrhinus brevis* (C. O. Waterhouse) and *Dusmoecetes marioni* Jeannel, are cryptogam feeders, often associated with bryophytes. Cryptogam herbivory, especially bryophyte and lichen feeding, is rare in the Curculionidae and it is suggested that this strategy evolved in response to the adverse conditions of the Pleistocene glaciations.

The Prince Edward Islands lie 2,300 km to the south-east of Cape Town in the South Indian Ocean Province (*sensu* Lewis Smith 1984) of the sub-Antarctic. Marion Island (46°54'S, 37°45'E) is the larger of the two islands which comprise the archipelago. It has a surface area of 290 km^2 and rises to an altitude of 1,230 m a.s.l. Prince Edward Island (46°38'S, 37°57'E) is one-seventh its size and rises to 670 m a.s.l. The islands are volcanic in origin and have an oceanic climate dominated by strong westerly winds, high humidities, low mean temperatures with little diurnal and seasonal variation, and high precipitation (see Schulze 1971).

The islands have a tundra-type biome (as defined by Wielgolaski 1972), which is similar to Arctic tundra, but differs from northern sites in a number of important aspects (French and Smith 1985). A total of 120 bryophyte species is known from the islands as opposed to the 22 indigenous vascular plant species. Despite the dominance in the number of bryophyte species, vascular biomass is higher in all the plant communities (Smith 1976), apart from those above 500 m where closed plant communities are not supported due to the harsh climate. In areas above 650 m no vascular species exist and the cryptogams predominate, with bryophytes assuming an important position.

The insect fauna of the islands is impoverished, with only 26 free-living species recorded (Crafford *et al.* 1986); Coleoptera, Diptera and Lepidoptera predominate. The bulk of the Coleoptera is represented by weevils belonging to the adelognathous tribe, Ectemnorhinini, the members of which are restricted to the islands of the South Indian Ocean Province (*viz.* the Prince Edward Islands, the Crozet Archipelago, Kerguelen, and Heard and Macdonald Islands).

During an investigation of the ecology and biology of the weevils it became apparent that all of the species feed on cryptogams and many live in bryophytes (to a greater or lesser extent depending on the species involved), habits which appear to be unusual for Curculionidae, as this family is known to have "systematically exploited the angiosperms" (Oberprieler and Louw 1985). This

Table 1. Ectemnorhinini of Marion and Prince Edward Islands, with incidence of cryptogam and bryophyte herbivory (indicated as a percentage of the individuals examined, which had fed on each item) and degree of association with bryophytes (determined by field observations and gut content analyses), as defined by Gerson (1982).

Species	Stage	n	Cryptogams	Bryophytes	Bryophyte association
Palirhoeus eatoni	Larvae	17	100	6	Bryoxene
	Adults	40	100	0	Occasional
Bothrometopus randi	Larvae	38	100	16	Bryoxene
	Adults	46	100	2	Occasional
Antarctonesiotes elongatus	Larvae	28	100	18	Bryoxene
	Adults	62	100	7	Occasional
Mesembriorrhinus brevis	Larvae	50	100	61	Bryophile
	Adults	116	98	21	Bryoxene
Dusmoecetes marioni	Larvae	67	97	97	Bryobiont
	Adults	1,314	88	88	Bryobiont
Dusmoecetes similis	Larvae	82	9	9	Occasional
	Adults	1,037	38	38	Bryoxene

paper gives an account of the importance of cryptogam herbivory in these weevils and discusses the evolutionary implications thereof.

METHODS

Adults and larvae of all six weevil species found on the Prince Edward Islands [*viz. Antarctonesiotes elongatus* Jeannel, *Bothrometopus randi* Jeannel, *Mesembriorrhinus brevis* (C. O. Waterhouse), *Palirhoeus eatoni* (C. O. Waterhouse), *Dusmoecetes similis* (C. O. Waterhouse) and *Dusmoecetes marioni* Jeannel] were collected indiscriminately on Marion Island from May 1986 to April 1988 and on Prince Edward Island during two four-day visits (April 1986 and April 1988). Each collection included a small part of the host-plant as well as pieces of any additional plants growing within a five centimeter radius of the animal. The animals and plant fragments were preserved in FAA within two hours of collection.

The gut contents of the weevils were dissected out in the laboratory, placed on microscope slides, and examined with a compound microscope at high magnification. The plant fragments found in the gut of the animals were compared with slide mounts of the host-plants, which in turn were compared with herbarium specimens, where these were available. Host-plant identifications were achieved in this manner.

RESULTS

Table 1 lists the weevil species found on the islands, the incidence of cryptogam and bryophyte herbivory in each species, and their degree of association with bryophytes (determined by field observations and gut content analyses), as defined by Gerson (1982). Briefly, his system is as follows: Bryobionts occur exclusively in association with bryophytes. Bryophiles are usually found on bryophytes, but may survive elsewhere. Bryoxenes regularly survive part of

Table 2. Some host-plants of *M. brevis* and *D. marioni.*

Species	Host-plant
Mesembriorrhinus brevis	*Andreaea acutifolia* (Andreaeaceae) *Bryum argentum* (Bryaceae) *Grimmia kerguelensis* (Grimmiaceae) *Orthotrichum crassifolium* (Orthotrichaceae) *Ptychomnion ringianum* (Ptychomniaceae)
Dusmoecetes marioni	*Acrobolbus ochrophyllus* (Hepaticopsida) *Blepharidophyllum densifolium* (Hepaticopsida) *Cryptochila grandiflora* (Hepaticopsida) *Fossombronia australis* (Hepaticopsida) *Herzogobryum atrocapillum* (Hepaticopsida) *Herzogobryum vermiculare* (Hepaticopsida) *Hygrolembidium ventrosum* (Hepaticopsida) *Jamesoniella colourata* (Hepaticopsida) *Pachyschistochila carnosa* (Hepaticopsida) *Cephaloziella* sp. (Hepaticopsida) *Plagiochila* sp. (Hepaticopsida) *Andreaea acutifolia* (Andreaeaceae) *Bryum argentum* (Bryaceae) *Campylopus subnitens* (Dicranaceae) *Ditrichum strictum* (Ditrichaceae) *Ptychomnion ringianum* (Ptychomniaceae)

their life cycle on bryophytes, and occasionals may, at times, be found in bryophytes, but do not depend on these plants for their survival.

Palirhoeus eatoni feeds almost exclusively on algae, and *B. randi* on algae and lichens. Both species rarely incorporate bryophytes into their diet although they pupate in moss cushions and often take shelter in these as larvae and adults. In the case of the latter species, the larvae often feed on algae and lichens growing within these cushions (either epiphytically or simply in association with them), and occasionally the moss itself. Both the adults and larvae of *A. elongatus* can, on occasion, be found sheltering in and feeding on *Andreaea acutifolia* cushions in fellfield areas, although it is predominantly a soil dwelling species. The larvae feed mainly on soil algae and cyanobacteria and the adults on soil cryptogams and epilithic lichens; *M. brevis* larvae are almost always found within moss cushions where they feed on bryophytes, algae and lichens. Table 2 lists some of the bryophyte hosts of this species. The adults are not as common as the larvae in moss cushions, although they do utilize these cushions for shelter, as oviposition sites and, occasionally, as foodplants, although they feed predominantly on algae and lichens. *Dusmoecetes marioni* is one of the commonest weevils on the islands and can be found wherever bryophytes occur. Adults and larvae may be found in, and feeding on, *Ditrichum strictum* cushions, *Bryum argentum* mats in seepages, and *Blepharidophyllum densifolium* carpets in mires, with larval densities of up to 1,200 individuals/m^2 in the latter habitat (unpublished data). Table 2 lists a number of the hosts of *D. marioni.* The last species, *D. similis,* is almost entirely restricted to angiosperm herbivory, but incorporates cryptogams (especially bryophytes) into its diet at the end of the growing season when the quality of the vascular plants deteriorates.

DISCUSSION

The various ways in which weevils utilize cryptogams on the Prince Edward Islands indicate the importance of these plants to these weevils and perhaps other insect species on the islands (see Crafford *et al.* 1986). Bryophytes are particularly of importance, in terms of shelter, especially when humidities are low and the surface temperature of the substrate high (*ca.* 25°C), providing cool, moist refugia. Most of the species pupate in moss cushions (*i.e.*, *P. eatoni*, *D. marioni*, *B. randi*, *M. brevis* and *A. elongatus*, although not exclusively in the latter species), and bryophytes also provide important oviposition sites.

As foodplants, bryophytes vary in their importance to the weevil species, but are essential to larvae of *M. brevis* and *D. marioni*. As with many other bryophagous insects (see Gerson 1982), the two abovementioned species are generalist feeders utilizing a wide variety of host-plants, and it is not implausible to suppose that these species, and the lichen feeding *B. randi* and *A. elongatus*, utilize mixed function oxidases to deal with the wide variety of allelochemics found in bryophytes (Gerson 1982) and lichens (Crowson 1981:604). The switching behaviour (*sensu* Mattson 1980) displayed by *D. similis* is also of interest as there is only one other example of a shift from vascular plants to bryophytes recorded in the literature, that of aphids of the subtribe Melaphidina which shift between *Rhus* and bryophytes (Eastop 1977).

Based on a taxonomic study of the genera in the Ectemnorhinini, and a study of habitat associations of the known species, three groups have been identified within the tribe, each with different food-plant associations (in prep.). It has been hypothesized (in prep.) that angiosperm herbivory represents the primitive condition in the tribe and that cryptogam herbivory evolved (with ensuing diversification of one of the groups mentioned above), in response to the adverse conditions of the Pleistocene glaciations, which precluded angiosperm herbivory. With the subsequent postglacial warm-up of the sub-Antarctic (see Scott 1985 for the Quaternary vegetation history of Marion Island), angiosperm herbivory has become a viable strategy, with a resultant radiation of the more advanced genera in the tribe.

Cryptogam herbivory, in particular bryophagy and lichen feeding, is not common in the Curculionidae, or for that matter the Coleoptera (Crowson 1981:604; Gerson 1982). Kuschel (1964, 1971) noted that species within the genera *Athor* Broun and *Bryocatus* Broun (Curculionidae: Erirhininae) are moss feeders. In addition two Neotropical Brachyderinae (*Sciomias* spp.) are known to be associated with cryptogams, one with moss and the other with lichens (A. Howden *in litt.*). Based on the abovementioned hypothesis and the limited occurrence of algae, lichen and bryophyte herbivory in the Curculionidae it seems reasonable to assume that cryptogam herbivory in the Ectemnorhinini is a highly adaptive trait, which evolved in a group whose members where unable to migrate, due to ocean barriers, and thus track the changing environment, as did many Northern Hemisphere species (see Coope 1979). This probably resulted in a rapid rate of evolution (with subsequent speciation), in the group, the only alternative to extinction. Kuschel (1960) has noted, however, that the majority of insects showing discontinuous distributions in the cold temperate regions of the southern hemisphere feed on lower vascular plants and that these insects can be classed as primitive. This should be kept in mind as an alternative hypothesis to the above one, especially as the position of the Ectemnorhinini in the Curculionidae remains unresolved (see, *e.g.*, Jeannel 1940; Kuschel 1970; May 1970).

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We would like to thank Prof. R. M. Schuster of the University of Massachusetts for identifying the liverworts and for lively discussion with one of us (SLC) on the topic of bryophagy. Prof. U. Gerson of the Hebrew University of Jerusalem and Mrs. Anne Howden of Carleton University provided us with references to bryophagy. Jan Crafford of this department is thanked for commenting on the manuscript. Biological research at the Prince Edward Islands is carried out under the auspices of the South African Scientific Committee for Antarctic Research (SASCAR). Financial and logistical support is provided by the South African Department of Environment Affairs.

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DISTRIBUTION, ECOLOGICAL, AND BEHAVIORAL NOTES ON *BLETHISA* IN MONTANA AND OREGON (COLEOPTERA: CARABIDAE)

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ABSTRACT

Blethisa multipunctata Linnaeus and *B. quadricollis* Haldeman are reported from Montana with notes on their habitats and associated ground beetles. Habitat, associated species, and distribution notes are also presented for *B. oregonensis* LeConte. Behavioral observations are given for *B. multipunctata* and *B. oregonensis*.

Lindroth (1954, 1961), Goulet and Smetana (1983), and Morgan *et al.* (1986) reviewed distributions of *Blethisa* from North America. The latter authors also provided notes on habitat and associated species of carabids. None of these authors reported any species of *Blethisa* from Montana. Russell (1968) recorded *B. multipunctata* Linnaeus from Montana, but this discovery was never published. This note is intended to report the occurrence of *B. multipunctata* and *B. quadricollis* Haldeman in Montana and to provide habitat and associated species data for these and *B. oregonensis* LeConte to complement similar information provided by Morgan *et al.* (1986).

Blethisa multipunctata. In May 1986, we confirmed Russell's record of this species approximately 260 km southeast of the closest known locality near Creston, British Columbia (Lindroth 1961). The site is at: **Montana,** Lake County, Ninepipe National Wildlife Refuge, el. 917 m, 9.7 km S. Ronan, 29.V.1986, P. J. Johnson & J. R. LaBonte. This may be the same site visited by Russell with the reported date of 24.VI.1967. Habitat conditions were physiognomically different from those described by Lindroth (1955, 1961). The site is at the shoreline of a shallow arm of Ninepipe Reservoir with extensive stands of *Typha latifolia* L. and *Juncus* sp. growing along the margins. Specimens were collected by submerging and agitating floating dead stalks of *T. latifolia* which had drifted against a gravel embankment forming a mat 2–5 cm thick and 30–40 cm across, in water up to 10 cm deep. Associated ground beetles were: *Agonum decorum* Say, *A. propinquum* Grey and Hatch, *Badister neopulchellus* Lindroth, *Bembidion acutifrons* LeConte, *B. patruele* Dejean, *Bradycellus californicus* LeConte, *Brachinus quadripennis* Dejean, *Chlaenius pennsylvanicus* Say, *C. sericeus* Forster, *Diplocheila striatopunctata* LeConte, and *Stenolophus anceps* Leconte.

Blethisa quadricollis. This species was collected at: **Montana,** Lake County, Simmons Meadow, el. 975 m, 22.5 km S. Swan Lake (P.O.), 29.V.1986, P. J. Johnson and J. R. LaBonte. This is a range extension of approximately 720 km southwest of the nearest recorded site in south-central Alberta (Morgan *et al.* 1986). The site superficially resembles the habitat described by Lindroth (1955), and is a fen formed in a glaciated stream bed. The beetles were collected in the wetter portion which was dominated by *Carex* spp., *Equisetum palustre* L., and *Phalaris arundinacea* L., in 4–14 cm of water. A drainage channel had been dug in the recent past, drying upstream reaches which were dominated by grasses, mostly *P. arundinacea.* All specimens were associated with a finely textured and loosely matted moss which formed extensive patches and shallow domes in slightly more open areas of *Carex* and *Equisetum.* These areas were well shaded by a nearby conifer copse during mid and late daylight hours. Associated ground beetles were: *Agonum affine* Kirby, *A. gratiosum* Mannerheim, *A. harrisi* LeConte, *A. lutulentum* LeConte, [*A. nigriceps* LeConte was recorded here by Russell (1968)], *A. propinquum* Grey and Hatch, *A. thoreyi* Dejean, *Badister grandiceps* Casey, *B. neopulchellus* Lindroth, *Bembidion concretum* Casey, *B. transparens* Gebler, *Bradycellus californicus* LeConte, *B. lecontei* Csiki, *Chalenius alternatus* Horn, *C. niger* Randall, *Dyschirius integer* LeConte, *Metabletus americanus* Dejean, and *Stenolophus anceps* LeConte.

Blethisa oregonensis. This species was not considered by Morgan *et al.* (1986) and only briefly mentioned by Goulet and Smetana (1983). It is apparently restricted to the Pacific Northwest. All specimens and records examined by us are from west of the Cascade Range, except for Klamath Lake in south-central Oregon. Most localities are in the Willamette River Valley, Puget Trough, and lower Fraser River Valley, with scattered sites along the coast from southern Vancouver Island to Newport, Oregon. In Oregon, we have repeatedly found this species in large numbers at: Benton County, Finley National Wildlife Refuge, 7.5 km NNW Monroe; this area being largely natural valley bottom streams and marshes. Specimens were quite common under partially embedded stones and mats of *Ludwigia palustris* (L.) Ell. growing on muddy, shallow-sloped shores of a drying pond. Dominant vegetation was *P. arundinacea, Carex* spp., *Spiraea douglasii* Hook., *Fraxinus latifolia* Benth., and *Rosa canina* L. Associated ground beetles were: *Acupalpus punctulatus* Hatch, *Agonum* (*Melanagonum*) spp., *Anisodactylus californicus* Dejean, *A. sanctaecrucis* Fabricius, *Badister ferrugineus* Dejean, *Bembidion coloradense* Hayward, *B. patruele* Dejean, *B. timidum* LeConte, *Bradycellus conformis* Fall, *Chlaenius pennsylvanicus* Say, *Dyschirius integer* LeConte, *Loricera decempunctata* Eschscholtz, and *L. pilicornis* Fabricius.

As mentioned above, we collected *B. multipunctata* by submerging and agitating a mat of floating vegetation. During this disturbance immersed individuals immediately floated to the surface, hydrofugically shed water, and began swimming toward shore. This is rather typical behavior for hydrophilic carabids, however, we also observed a number of individuals entering submerged portions of the mat by rapidly crawling down plant stalks. These beetles would remain under water and could not be retrieved without extensive agitation, this causing them to release their hold, float to the surface and swim for shore.

Subsequent to these observations, LaBonte placed specimens of *B. oregonensis* in an aquarium with a floating, dense mat of aquatic plants and a "shoreline." Following several days of acclimatization these beetles were disturbed by prodding, whereupon they entered the water by traveling down plant stems.

Without further disturbance individuals were observed either clambering about the plants or remaining immobile for up to 3 minutes before resurfacing. On occasion individuals were observed to voluntarily enter the water also by traveling down plant stems. These observations support conclusions by Arens and Bauer (1987) in their study of the "diving" behavior of European *B. multipunctata.* They suggested that such aquatic capabilities were adaptations to annual flooding of riparian habitats. Our observations indicate that "diving" is typical of *Blethisa* in general, but we believe that such behavior may also function as a predator-escape response. Events of voluntary submersions suggest potential for aquatic foraging similar to that reported for some European *Carabus* (Thiele 1977) and the South American *Stratiotes batesi* (Adis 1982).

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NOTES ON *MIGNEAUXIA ORIENTALIS* REITTER, A GENUS AND SPECIES NOT PREVIOUSLY RECORDED FROM NORTH AMERICA (COLEOPTERA: LATHRIDIIDAE: CORTICARIINAE)

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ABSTRACT

Migneauxia orientalis Reitter 1877, an oriental species, is recorded for the first time from southern United States and northern Mexico. A brief description, illustrations and known geographic distribution in North America are provided.

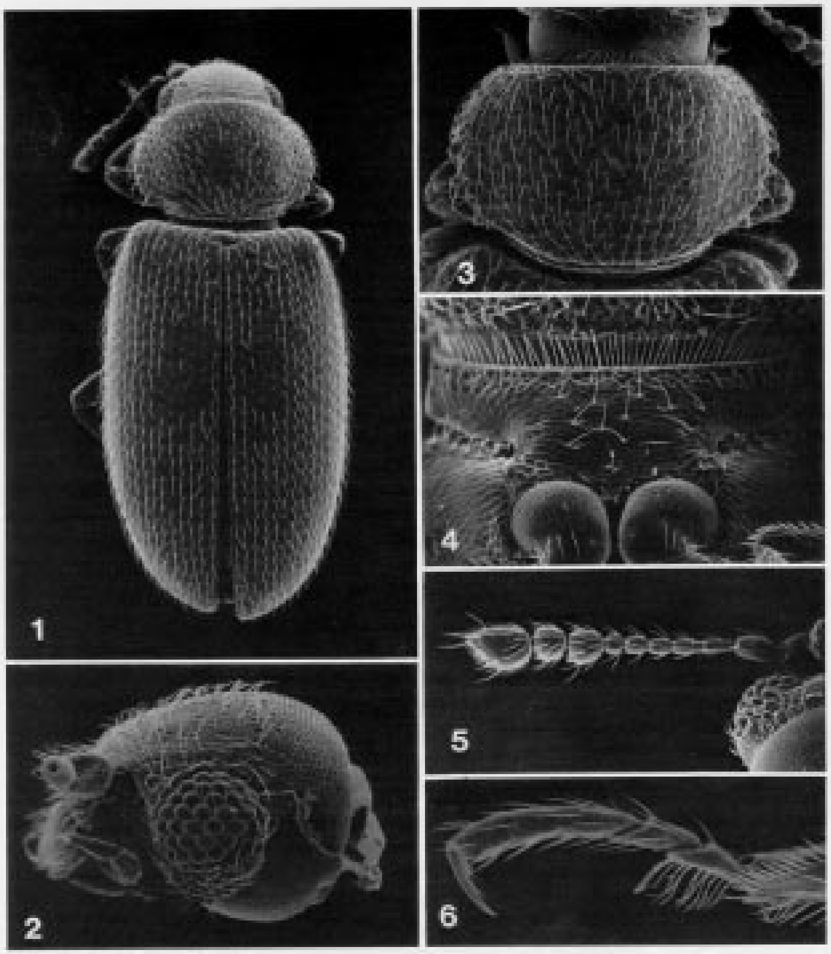
Migneauxia orientalis Reitter 1877 was described from India and has subsequently been recorded from Indochina, Japan, Denmark and Colombia. Hinton (1945) listed it as a pest of stored food. Recent collecting has shown it to be uncommon, but widespread, in southern United States and northern Mexico and locally abundant at several locations in California and Baja California.

It is a distinctive species and is readily recognized in collections. The 10-segmented antennae, transverse pronotum with strongly rounded sides and four or five large distinct teeth in the posterior one/half in combination with fully developed eyes will differentiate it from any other North American Corticariinae.

Migneauxia orientalis Reitter 1877

DESCRIPTION. Length 1.2–1.6 mm. Width 0.5–0.7 mm. Body elongate-oval, convex; dorsal surface clothed with short semi-erect setae (Fig. 1). Cuticle shining, reddish-brown to testaceous; head, pronotum and venter imbricate-punctate (see Harris 1979 for definition). Head short, ⅔ width pronotum; tempora wanting; eyes well developed, 32–34 facets, reduction of facets on lower posterior margin (Fig. 2); antenna 10-segmented, abruptly formed 3-segmented club (Fig. 5). Pronotum transverse, length 0.55 × width, width 0.8 × width of elytra; lateral margin rounded, narrowed anteriorly, posterior ½ with 4 or 5 large distinct teeth (Fig. 3). Elytra oval, 16 rows of semirecumbent setae. Scutellum transverse, terminally with 3 or 4 setae. Prosternum with conical pits anterior to coxa (Fig. 4). Procoxal separation $\frac{1}{10}$ coxal width. Mesocoxal separation ¼ coxal width. Metacoxal separation subequal to coxal width. Abdomen 5-segmented; proportional length segments 1 to 5, male—4.0:1.3:1.0:1.0:1.4; female—3.2:1.2:1.0:1.0:1.4; terminal segment densely setose and medially depressed. Length tarsal segments 1 and 2 subequal, segment 3 subequal to 1 + 2. First tarsal segments of anterior and middle legs of male with elongate setal pad ventrally (Fig. 6). Male tibia with movable, bifurcate spur at terminus (Fig. 9). Male aedeagus broad, narrowed at tip, ventrally curved (Figs. 7, 8).

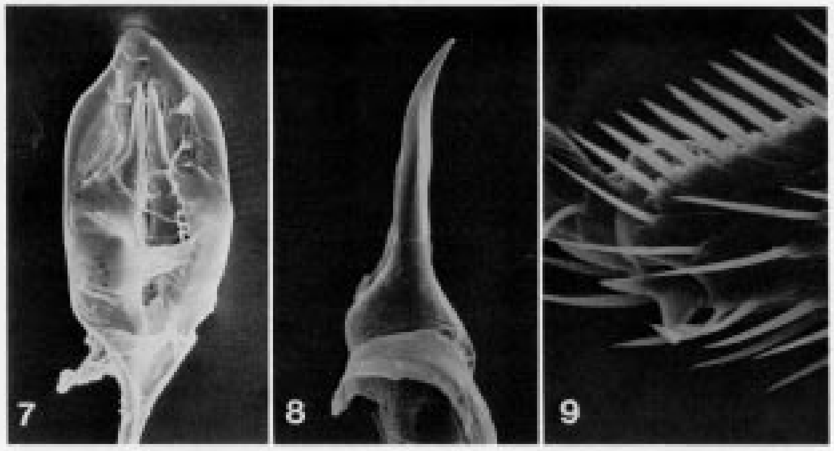
REMARKS. Most specimens were collected at blacklight and in arid, desert or near-desert areas. There are nine described species in the genus, all known from the Old World in the areas surrounding the Mediterranean. This area is



Figs. 1–6. *Migneauxia orientalis* Reitter. 1, Dorsal habitus. 2, head, lateral view. 3, pronotum, dorsal view. 4, procoxal fovea. 5, antenna. 6, tarsus, male proleg.

primarily desert or near-desert and is similar in climate to the climate of the area *M. orientalis* occupies in North America. The earliest date on the specimens examined was 1947 at Riverside, California. It would seem that *M. orientalis* is a recent introduction into North America. The collections from the desert areas of California and Mexico are generally large (over 200 specimens from Isla San Estaban, Baja California), while the collections from the more temperate areas (central California and Georgia) are usually of a single specimen.

The prosternal foveae of specimens from Bullhead City, Arizona, and Isla San Estaban, Baja California, are packed with fungal spores (Fig. 4). It would appear that the function of these foveae is mycangeal. *Migneauxia* shares the presence of prosternal foveae with *Corticaria* and *Fuchsina*.



Figs. 7–9. *Migneauxia orientalis* Reitter. 7, aedeagus, ventral view 8, aedeagus, lateral view. 9, movable spine, male protibia.

DISTRIBUTION. The known geographic distribution in North America is given below.

UNITED STATES: **Arizona:** *Maricopa Co.:* Phoenix, VII. *Mohave Co.:* 8 mi. S Bullhead City, X. *Pima Co.:* Tucson, IV, VII, IX. *Pinal Co.:* Stanfield, VIII. **California:** *Imperial Co.:* Algodones Dunes, IV, V, VII, IX; 3 mi. N Brawley, II; Calexico, VIII, IX; El Centro, VIII, XII; Holtville, IX; 9.3 mi. S Walters Camp, IV; Westmorland, X. *Los Angeles Co.:* Tujunga, III. *Orange Co.:* Santa Ana, IX. *Riverside Co.:* 0.5 mi. SE Aguanga, IX; Blythe, VIII; Deep Canyon, VIII; Lamb Canyon, 2 mi. NW Gilman Hot Springs, III; Palen Dunes, IX; 5 mi. NE Palo Verde, II; Painted Canyon, V. *San Bernardino Co.:* Joshua Tree National Monument, VIII. *Shasta Co.:* Redding, X. *Tulare Co.:* Strathmore, I; Visalia, VIII. **Georgia:** *Bibb Co.:* Georgia Forestry Comm. Station, VIII. **Texas:** Quarantine from Texas, IX.

MEXICO: **Baja California:** Isla San Esteban, II. **Jalisco:** 20 mi. SW Autlan, VII. **Sinaloa:** Esquinapa Beach, IX; 2 mi. E San Blas, VII. **Sonora:** 11.4 mi. E Guymas, IX; San Carlos Bay, VIII.

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BOOK REVIEW

JACQUES, R. L. 1988. **The potato beetles. The genus *Leptinotarsa* in North America (Coleoptera: Chrysomelidae).** Flora & Fauna Handbook No. 3. E. J. Brill, New York. 144 pp. (ISBN 0-916846-40-7). US$14.95.

"The potato beetles" is the third book in the series "Flora & Fauna Handbooks." Its bright blue cover immediately attracts the attention, and the back cover reproduces a nice plate illustrating five brightly colored species, an original way to incorporate color plates in a book.

The book is divided into six chapters. The first five chapters deal with the general classification of the potato beetles, the plant hosts and specificity (with a description and illustration of the most important host plants), the early history (basically that of the Colorado potato beetle), a discussion on research methods, and a short chapter on the biology (largely based on observations on the Colorado potato beetle). The sixth chapter is on the taxonomy, including a key to the 31 North American species, synonymies, descriptions, illustrations of the elytral pattern and male genitalia, locality records, and distribution maps.

The presentation is pleasant and the quality of the illustrations good. The drawings of the male genitalia are quite sketchy, but good enough to show the important features.

The references should have been more carefully cross checked. For example, Dodge (1949), Salaman (1949), Klein (1987), etc., are cited in the text, but are not listed in the bibliography. I do not understand why some major entomological collections were ignored (California Department of Food and Agriculture, Canadian National Collection, Museum of Comparative Zoology, etc.). Insufficient material led the author to make statements on the distribution of some species that are not entirely accurate. The Colorado potato beetle, for example, is not mentioned for the Canadian Maritime Provinces where it is the most important crop pest!

Considering all positive and negative aspects of this book, the balance is definitively largely positive, and this revision represents a useful contribution to the knowledge of the taxonomy of leaf beetles.

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OPLOSTOMUS FULIGINEUS (COLEOPTERA: SCARABAEIDAE): LIFE CYCLE AND BIOLOGY UNDER LABORATORY CONDITIONS, AND ITS OCCURRENCE IN BEE HIVES

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ABSTRACT

Oplostomus fuligineus Olivier (Cetoniinae: Cremastocheilini) has been known as a pest in bee hives in southern Africa since the early 1900's. This is the first description of its life cycle and breeding habits. Eggs were laid in a mixture of soil and cattle dung and took 6 to 10 days (mean 7.9 days) to hatch. The larvae (description is given) were fed on a mixture of soil, compost and cattle dung in the ratio of 1:2:3 by volume and took 30 to 38 days (mean 33 days) to become pupae. The pupae took 21 to 29 days (mean 25 days) to eclosion. Survival rate of eggs was 95%, larvae 61% and pupae 71%. Female and male adults could be distinguished by the shape of the abdominal sternites. They fed preferentially on open bee brood containing larvae, also on young capped brood and survived well on pollen and honey. In nature they seldom feed on flowers as do other Cetoniinae.

The black hive beetle *Oplostomus fuligineus* Olivier is a predacious, African, scarabaeid species belonging to the tribe Cremastocheilini and has the inferior synonym *Hoplostoma.* It has been known to apiarists as a pest in bee hives in southern Africa since the early 1900's (Fuller 1921). However, nothing has been published on the breeding habits of this cetoniine beetle although H. Ashenbourne (pers. comm.) of the CSIRO Dung Beetle Unit in Pretoria has discovered beetles in their hard, mud cocoons under old cattle dung on a farm east of Pretoria.

With this information and my previous experience of rearing Cetoniinae I attempted to rear *O. fuligineus* in the laboratory to determine its feeding preferences and the length of its life cycle (Donaldson 1987). Its life cycle was compared with that of *Pachnoda sinuata flaviventris* Gory and Percheron, which has also been found in bee hives.

REARING CONDITIONS AND PROCEDURE

The laboratory conditions and rearing procedure were similar to those used for *P. s. flaviventris* (Donaldson 1985). Temperatures in the laboratory were controlled at 24 ± 2°C, the relative humidity varied between 50 to 90% and the daylight period was 13 hours. The wooden framed cages had wire gauze walls and measured 48 cm by 54 cm by 48 cm high. Beetles were provided with drinking water in a petri dish containing wet cotton wool and with a basin (3.5 litre, diameter 25 cm, depth 12 cm) of damp pasteurized soil mixed (1:1 by volume) with sifted damp cattle dung, which had been in a deep freeze at about −15°C for at least 24 hours and returned to ambient temperature before use.

Table 1. Changes in the shape and calculated volume of *Oplostomus fuligineus* eggs during development after deposition in the laboratory.

Period after deposition (days)	No. eggs measured	Mean length (mm)	Mean width (mm)	Volume (mm^3)[a]		
				Range	Mean	SE[b]
1	10	2.08	1.60	2.25–3.69	3.15	±0.150
3	10	2.50	2.27	5.14–7.67	7.08	±0.283
5	10	2.79	2.61	9.31–11.65	10.46	±0.406

[a] The volume was calculated by using the following formula:

$$V = L - D \times \pi\left(\frac{D}{2}\right)^2 + \frac{4}{3}\pi\left(\frac{D}{2}\right)^3$$

where L is the longest and D is the width or shorter measurement.

[b] Standard error.

The beetles were fed pieces of fresh bee brood (50 cm by 5 cm by 2.5 cm thick) when available, but usually the brood had been in a deep freeze. In some experiments they were fed a mixture of pollen and honey or pollen and honey separately in 4 cm diameter petri dishes.

Eggs were collected from the soil and dung mixture and placed on damp filter-paper in petri dishes until they hatched. Larvae were fed on a diet of damp pasteurized soil, compost and thawed cattle dung mixed in an approximate ratio of 1:2:3 by volume, which was replaced every two weeks. Pupae were placed in containers of damp pasteurized soil until the beetles emerged.

RESULTS AND DISCUSSION

Biology of the Egg

The eggs are white and oval, but become more spherical and increase in volume as they absorb water during development. Measurements of developing eggs which were laid in the laboratory by field-collected beetles are given in Table 1. The total hatching period from oviposition was 6 to 10 days with a mean of 7.9 days. Toward the end of this period the sclerotised tips of the upper mandibles could be seen under the chorion, as in *P. s. flaviventris* (Donaldson 1985), and just before hatching the abdominal setae also became visible. The hatching rate in the laboratory was 95%.

Biology of the Larva

The newly hatched larva has a white head capsule which turns brown in a few hours to match the brown setae and spiracles. These larvae resemble the larvae of species from four other cetoniine tribes, *i.e.,* Goliathini, Cetoniini, Gymnetini and Diplognathini (Krikken 1984) that I have reared, except that the bodies of *O. fuligineus* larvae are soft and flaccid. Also, the distal abdominal segments are greatly swollen, particularly in the third instar, so that the larvae are almost pear-shaped. These larvae of the Cremastocheilini are not back-crawlers, as in the other four tribes, but use their legs for crawling.

The general description by Donaldson (1987) of cetoniine larvae also applies here, except that the maxillary stridulatory area has up to 11 teeth.

First instar. Maximum width of head capsule 1.8 to 2.0 mm and dark ocelli. Teges with a few interspersed shorter setae.

Second instar. Maximum width of head capsule 3.1 to 3.3 mm and ocelli dark. Teges with a few shorter setae interspersed.

Third instar. Maximum width of head capsule 5.0 to 5.2 mm, the cranium yellow brown in colour and ocelli dark. The last antennal segment with 2 to 3 ventral and 2 dorsal sensory spots. Left mandible with 4 and right with 3 scissorial teeth. Mesothoracic claw curved, brown with dark tip and with 2 ventral setae. Teges without palidia, but some shorter setae, ⅓ to ½ length of others, but same thickness, scattered among others in the area.

Material examined. Fourteen larvae of the first instar, 8 of the second and 6 of the third instar.

From the time of hatching, larvae took 6 to 11 days (mean 9 days, n = 85) to reach the second instar; 13 to 17 days (mean 14 days, n = 73) to reach the third instar and 30 to 38 days (mean 33 days, n = 52) to become pupae. The survival rate of larvae under present rearing conditions was 61%. The larval cycle is much shorter than that of *P. s. flaviventris* (mean 88 days) reared under similar conditions.

Biology of the Pupa

The newly formed pupa is creamy white, but turns brownish-cream and before eclosion it becomes a light reddish-brown. In shape it is a typical cetoniine pupa with the elytra folded forward and, except for the genital capsule, resembles that of *P. s. flaviventris* (Donaldson 1985). In *O. fuligineus* the hind margin of the pronotum is less sinuate, but the central suture on the pronotum and scutellum is more pronounced than in *P. s. flaviventris.* The posterolateral angle of the pronotum also bears an oval tubercle or knob, which is slightly larger than that in *P. s. flaviventris* when compared with the area of the pronotum. There are functional abdominal spiracles on segments 1 to 4, as also in *P. s. flaviventris.* The pupa is enclosed in a mud cocoon which becomes extremely hard when dry. Unlike *P. s. flaviventris* cocoons, those of *O. fuligineus* were not attached to the bottom of the rearing bowls, but they were found loose in the medium. Pupae took 21 to 29 days (mean 25 days) from the time of formation to eclosion and their survival rate was 71%. Of 43 pupae reared 27 produced females and 16 males; the reason for the predominance of females is not known. Field-caught populations also varied in their sex ratios, which did not appear to be correlated with obvious seasonal or weather variations.

Biology of the Adult

Females and males can be separated by the shape of the abdominal sternites; in the female these are rounded, whereas in the male they tend to be flattened and have a central groove on sternites 2 and 3 (and sometimes 4) which may be faint in some specimens.

The mouthparts of *O. fuligineus,* as in other Cremastocheilini, are greatly modified, presumably as a result of their predacious habits: the mentum is enlarged covering the insertions of the labial palps and the monodentate galea is sharply acute apically (Evans and Nel 1989). The ligula is monolobed, not bilobed as in *P. sinuata,* but the mandibles are typically cetoniine (A. Nel, pers. comm.). In the field and in the laboratory the beetles fed on open brood containing larvae, but in its absence fed on soft young capped brood. They would not eat brood which contained callow adult bees. Caged beetles in a laboratory usually fed on the underside of a piece of comb in a dish, even though the same type of brood was present on the upper and lower surfaces.

Phytophagous species which do not have these modified mouthparts are not precluded from being predacious. In a laboratory experiment *P. s. flaviventris,* which has been found in bee hives by Johannsmeier (1980) and Clauss (1983), was fed comb containing young brood and pollen. Within a few hours the beetles reduced most of the comb to shreds and ate pollen as well as the bee brood.

An experiment was set up to test whether *O. fuligineus* could survive on pollen and honey without any bee brood. From a field-caught population 20 females and 10 males were placed in each of two cages. Beetles in the one cage were given bee brood, but those in the other cage were given two dishes, one of honey and another of dry pollen that had been collected from bees. The duration of the experiment was from 11 January to 18 February, during which period those fed bee brood laid 25 eggs and those fed honey and pollen did not lay any eggs. Of those fed bee brood three females and seven males survived, whereas of those fed honey and pollen nine females and six males survived, indicating that though the beetles' fecundity dropped, they survived well without bee brood.

Field-caught beetles each laid several batches of one or two eggs when fed bee brood in the laboratory. Beetles collected in November and December laid more eggs (5.8 eggs per female for 87 females) than those collected in January and February (0.5 eggs per female for 50 females). A batch of 68 females (males were discarded on this occasion) collected on 10 March and discarded on 6 May laid no eggs. Ten of the 60 survivors were dissected before being discarded and only two contained a few undeveloped ova and the others had none. This might have been due to the senility of the beetles, or to there being no males present for stimulation, as occurs with *P. s. flaviventris.*

In other experiments, caged *O. fuligineus* were tested to determine whether they would eat fruit or flowers. Grapes sliced open, rehydrated dried peach halves, fresh figs in halves and yellow roses in a jar of water, all of which are very acceptable to *P. s. flaviventris* and other Cetoniinae, were placed in the cage on separate occasions, as well as fresh blossoms of *Acacia karroo* Hayne and *Ziziphus mucronata* Willd. standing in a jar of water. Beetles were seen on the *A. karroo* blossoms and eating the grapes and figs, but there were no signs of feeding on the peach, roses or *Z. mucronata.*

The F1 generation produced in the laboratory did not lay eggs even though they were fed on bee brood. Of these 23 females and 12 males, which emerged between 4 to 8 February, only three females and two males survived until mid-May. The last two beetles, both females, died the following year on 20 January. This indicates that the life span of most *O. fuligineus* is only a few months and is not solely controlled by environmental conditions.

Field Observations

Oplostomus fuligineus emerge during the summer and are found in bee hives from October, but by the end of May the field populations have largely died out. Beetles have never been reported in bee hives during the winter (Johannsmeier, pers. comm.), so they probably overwinter in the larval and/or pupal stages, as do other Cetoniinae (Donaldson 1984). Beetles are active during the daytime, although they are black, and have never been recorded feeding on fruit or flowers, as with other Cetoniinae. However, some have been seen on protea flowers, and one or two on rare occasions have been caught in banana baited traps hung in the indigenous mixed bush 20 km east of Pretoria (E.

Holm and A. Evans, pers. comm.). They have long been associated with bee hives particularly in the sandveld and warmer areas of the Transvaal (Johannsmeier 1980). Between 1974 and 1987 a total of 19 bee hives were set up on a farm on sandveld, 45 km east of Pretoria. Two or three hives were set up at the same time for periods of three to four months between August and March and were observed monthly. All the hives contained *O. fuliginеus* in numbers ranging from one to 750 with a mean of 65 beetles per hive per observation for 66 observations (Johannsmeier, unpubl. data). Other Cetoniinae found in hives in much lower numbers (usually <10) were *Anisorrhina flavomaculata* (F.), *Diplognatha gagetes* McLeay, *Poecilophila hebraea* (Olivier) and particularly *Pachnoda rufa* (de Geer) and/or *Dischista cincta* (de Geer). No distinction was made between *P. rufa* and *D. cincta,* because they look alike and often occur together. They tended to be more prevalent than *O. fuligineus* in bee hives on the highveld near Krugersdorp and at Halfway House, where all these species occurred in much lower numbers than in the warmer areas (Johannsmeier, unpubl. data).

Oplostomus fuligineus has also been reported near Gabarone in Botswana though it rarely occurs in the Kalahari (Clauss 1983). It occurs on the sandveld northwest of Windhoek (Eggers and Wurst-Henning 1944), and Silberrad (1976) found this species in hives in Zambia. B. Buys (pers. comm.) reports that they occur in all four provinces of South Africa.

On rare occasions Johannsmeier (pers. comm.) has found a few dead beetles, *O. fuligineus* and *P. rufa/D. cincta,* partly covered in propolis lying on the bottom of hives on the highveld and a similar observation was reported by R. Hepburn (pers. comm.) in Port Elizabeth. It is not known whether the beetles died as a result of being propolised or whether they were propolised after death. The latter is more probable since dead decaying beetles give off a foreign odour in a hive, which may have aroused the bees.

Apart from having been seen feeding in bee hives at the Vegetable and Ornamental Plant Research Institute, 30 km northeast of Pretoria, *O. fuligineus* has been seen eating into nests of *Polistes smithii* de Saussure. In a preliminary attempt to rear the beetles they were offered the papery nest of this wasp from which they ate the larvae and pupae readily. They have also been seen eating the brood of the paper wasp *Belanogaster* sp. by Clauss (1983) in Botswana, and by Keeping (1984) at the Sterkfontein caves on the western Transvaal highveld.

O. fuligineus has a typical life cycle and larval feeding habits for the Cetoniinae, but the female and male adults are facultative predators on bee hives and wasp nests.

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INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

The following appeared in the *Bulletin of Zoological Nomenclature,* vol. 45(4) or 46(1). Anyone wishing to comment on these cases is invited to send the contribution, in duplicate, to the Secretary as quickly as possible.

Case 2585 (p. 278). *Ophonus* Dejean 1821 and *Tachys* Dejean 1821 (Carabidae): proposed designation of type species. Purpose is to retain the generic names in their accustomed usage by designation of *Carabus sabulicola* Panzer 1796 and *Tachys scutellaris* Stephens 1828 as their respective type species.

Case 2646 (p. 28). *Ptochus* Schoenherr 1826 (Curculionidae): proposed conservation by confirmation of Marshall's (1916) designation of *Ptochus porcellus* Boheman in Schoenherr 1834 as the type species. Purpose is to conserve the generic name by setting aside an overlooked and inadvertent type designation of a misidentified species and to confirm the designation of the above as type species.

Opinion 1525 (p. 65). *Phymatodes* Mulsant 1839 (Cerambycidae) and *Phymatestes* Pascoe 1867 (Tenebrionidae): conserved.

Opinion 1526 (p. 67). *Nanophyes* Schoenherr, 1838 (Curculionidae): conserved.

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IMMATURE *LEBIA VIRIDIS* SAY (COLEOPTERA: CARABIDAE): BIONOMICS, DESCRIPTIONS, AND COMPARISONS TO OTHER *LEBIA* SPECIES

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ABSTRACT

In northern Florida, *Lebia viridis* Say is found in association with the chrysomelid, *Altica foliacea* LeConte, larvae and adults of which feed on Evening Primrose (*Oenothera* spp.). Field observations from September 1987 through July 1988 indicate that *L. viridis* is a spring breeder and that the larvae are ectoparasitoids of *A. foliacea* pupae. Rearing of *L. viridis* in the laboratory on *A. foliacea* reveals three instars (two larval, one pupal) which are similar to the three instars of previously described *Lebia* spp. All instars of *L. viridis* are described and illustrated. Laboratory reared teneral adults are metallic blue in color and gradually change color to metallic green as they mature. Differences in structure and development distinguish larvae of *L.* (*Lebia*) *viridis* from those of *L.* (*Lebia*) *scapularis* Fourcroy larvae.

Though carabid beetles are major predators in agricultural ecosystems (Thompson 1979), their larvae are difficult to observe, as most are subterranean and/or secretive, and are laborious to rear (Goulet 1979). Yet, because carabids make up a major component of agricultural ecosystems (Thompson 1979:209), it is paramount these difficulties be overcome to gain a better understanding of these larvae. As of 1979, only 258 of *ca.* 2,500 North American carabid species had described larvae (Thompson 1979). There is a particular paucity of knowledge of the larval life histories of the members of the genus *Lebia* Latreille, in which only larvae of one North American species have been described previously.

The cosmopolitan genus *Lebia* is composed of *ca.* 450 species worldwide. This is the most diverse genus of the tribe Lebiini, which is composed of *ca.* 60 genera worldwide (Erwin and Sims 1984). The majority of adult *Lebia* are semiarboreal predators. The larvae, at least the ones known in this stage, are ectoparasitoids of the pupae of chrysomelid beetles. Of the 47 species in North America recognized by Madge (1967), only *Lebia grandis* Hentz, a parasitoid of the Colorado potato beetle (*Leptinotarsa decemlineata* Say), has a described larval development (Chaboussou 1939). Larval development has been described for two other *Lebia* spp., both from Europe: *L. scapularis* Fourcroy feeding on *Galerucella luteola* Müll. (Silvestri 1904) and *L. chlorocephala* Hoffman on *Chrysolina varians* Schall. (Lindroth 1954). These three *Lebia* spp. are not closely related and have been placed in three separate subgenera via adult characteristics: *L.* (*Loxopeza*) *grandis*, *L.* (*Lebia*) *scapularis*, and *L.* (*Lamprias*) *chlorocephala* (Madge 1967; Lindroth 1971).

These three species have the following traits in common. 1) Eggs covered with an adhesive secretion from the accessory glands are laid singly on the soil (Madge 1967). 2) The first instar larvae hatch out within one to two weeks, and at that time look like typical carabid larvae. 3) They actively "hunt" their hosts' pupating larvae and/or pupae in the soil and feed on them. 4) During feeding the larva becomes greatly distended, increases in length, and becomes relatively immobile. This is atypical of carabid larvae (Erwin 1967). 5) The larva then molts to a second instar after consuming an individual host pupa (*L. scapularis* spins a cocoon from silk secreted from the malpighian tubes before molting). 6) The second instar differs from the first by a reduction in all appendages and a loss of body sclerites (Madge 1967). It is even more immobile than the first and it does not feed. 7) Finally it molts into a pupa, then into an adult (*L. scapularis* molts into a prepupa prior to the pupal stage).

In North East, Pennsylvania, Isely (1920) reported *L. viridis* to be the most common carabid associated with the grapevine flea beetles, *Altica chalybea* Illiger and *A. woodsi* Isely. He reported *L. viridis* to feed on the eggs, larvae, and pupae of both flea beetles. Hemenway and Whitcomb (1967) reported *L. viridis* in association with *A. foliacea* LeConte on Evening Primrose (*Oenothera* spp.) in Arkansas. In addition, Lindroth (1971) reported *L. viridis* in association with *A. ulmi* Woods on *Ulmus americana* in southern Ontario.

Adults of *Altica foliacea* are metallic blue to green and just slightly larger than adults of *L. viridis*. To the casual eye, adults of these two species are very similar to one another (see Balsbaugh 1967) and this resemblance has been noted as a possible case of Batesian mimicry by Lindroth (1971). *Altica foliacea* feeds on *Oenothera* spp. as larvae and adults; however, the adults eat mesophyll of leaves of many species of plants if *Oenothera* is not present. In northern Florida and southern Georgia the adults are pests of the ornamental Crape Myrtle (*Lagerstroemia indica* L.) during the summer months, after *O. lacineata* Hill and *O. speciosa* Nutt. die, and before *O. biennis* L. begins to grow (Mizzel, pers. comm.[1]). Gravid females stick their eggs to the upper and lower surfaces of the leaves of *Oenothera* spp. (pers. obs.). The larvae feed on the leaves and the flower buds of *Oenothera*, then crawl to the ground and bury themselves in the soil or leaf litter. Here they form a pupal cell, pupate, and emerge as adults, which dig out of the cell.

Madge (1967:179) has recognized three forms of *L. viridis*: "a shiny metallic form, a dark form, and a dull blue form," referred to as *viridis, moesta,* and *subopaca* respectively. He suggested that they may be "polymorphic variants adapted to mimic various species of the probable host genus *Altica*." He speculated that "the dull blue form may be mimicing the dull blue *A. oblitera* LeC. which occurs in the southwestern United States."

In Leon County, Florida, I observed *L. viridis* in association with *A. foliacea* on *O. biennis, O. lacineata,* and *O. speciosa*. Larvae and pupae of *L. viridis* were found in the presence of thousands of *A. foliacea* pupae in the soil beneath *O. lacineata*. Adult *L. viridis* were collected and paired, and they mated. A portion of the eggs produced were reared to adult beetles. The larval life history, as observed from field and laboratory specimens, is recorded here with descriptions and illustrations of all instars.

MATERIALS AND METHODS

From September through November 1987, weekly evening field observations of two hr duration were made at a large patch of *O. biennis* found at

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[1] R. Mizzel: University of Florida AREC–Monticello, Route 4, Box 63, Monticello, FL 32344, U.S.A.

Innovation Park, *ca.* 5 km southwest of Tallahassee, Leon County, Florida. The population densities of *A. foliacea* and *L. viridis* were monitored and the behavior of *L. viridis* recorded.

From April through June 1988, two to three times a week, morning and evening field observations of one hr duration were made at a large patch of *O. lacineata* located *ca.* 120 m from the patch of *O. biennis* listed above. The population densities of *A. foliacea* and *L. viridis* were monitored and notes on the behavior and development of both beetle species recorded.

Beginning in early April 1988, adult *L. viridis* were collected from the patch of *O. lacineata* listed above. Male and female beetles were paired and then housed in 100 × 15 mm petri dishes with a moist sand-vermiculite mixture where females laid eggs. The paired beetles were fed *A. foliacea* eggs, larvae, and pupae. Eggs and any eclosed larvae were collected every two days, counted, and these counts recorded. Collected eggs were placed in 60 × 15 mm petri dishes on two layers of moist filter paper. Newly eclosed larvae were transferred to 60 × 15 mm petri dishes, each of which held a single *A. foliacea* pupa in a cell in the moist sand-vermiculite medium. Notes on larval development were recorded starting from the date the individual egg was laid. Larvae and pupae were killed at all major divisions of the life cycle, prepared for microscopy following the methods of Goulet (1977), and then stored in glass vials in glycerine (note: because of their delicate state, second instar larvae were not treated with potassium hydroxide). The larvae and pupae were studied using a binocular compound microscope at 10–1,000×.

Descriptions of laboratory-reared *L. viridis* are based on observations of 253 first instars before feeding, 33 first instars after feeding, 25 second instars, 14 pupae, and 12 teneral adults. Voucher specimens are in the Biosystematics Research Centre, Agriculture Canada, Ottawa, Canada.

Differences from Bousquet and Goulet's (1984) hypothesized primary setae of ancestral carabid larvae are listed following these authors' setal naming system. Additional and secondary setae are named following Bousquet and Goulet's guidelines.

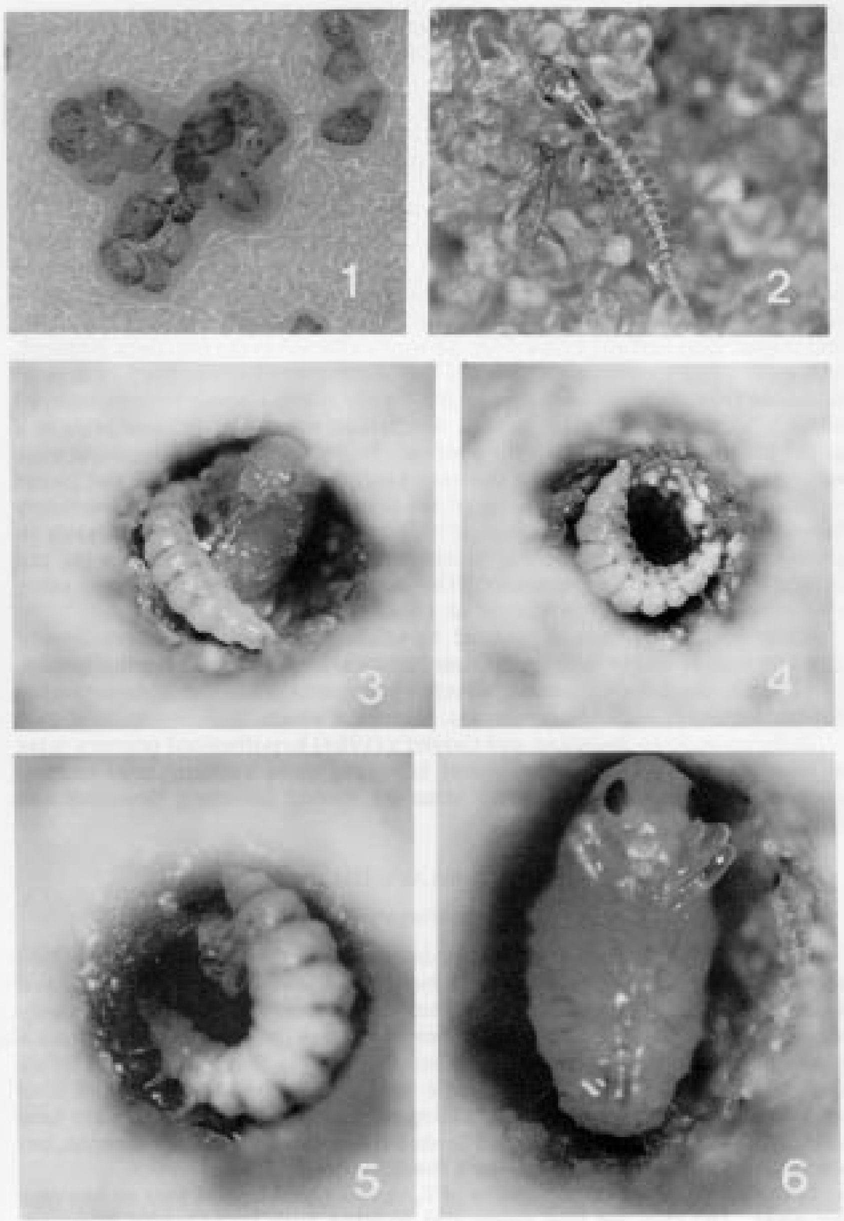
OBSERVATIONS AND RESULTS

Life History

Pairs of *L. viridis* were observed *in coitu* during April and June in the field and during May and October in the laboratory. Mating occurred at night and during crepuscular hours, but not during daylight hours. Copulation usually takes place on the ground. The male beetle mounts the female and assumes a position identical to that observed by Erwin (1967) in *Brachinus pallidus*: fore tarsi on the female's pronotum, middle tarsi on the elytral humeri, and hind tarsi on the elytral apices. During mating the antennae of both sexes are held straight forward. Intromission lasts from a few seconds to *ca.* one minute, but some males remained mounted for a few minutes.

In the laboratory, gravid females of *L. viridis* typically laid four or five eggs per night. The eggs are laid singly and covered with an adhesive secretion, which forms a capsule around the egg and holds it to the substrate. Females apparently oviposit after dark, because no oviposition was observed during many hours of daylight and twilight observations.

Observations on the development of eggs at room temperature (*ca.* 78°F) were made by removing the sand capsule with a set of probes. Eyespots formed



Figs. 1–6. *Lebia viridis.* 1, five day old egg. 2, first instar larva before feeding. 3, first instar feeding on *Altica foliacea* pupa. 4, first instar after consuming *A. foliacea* pupa. 5, second instar larvae. 6, pupa.

between three to four days after oviposition and the mandibles began to darken on the fourth day (see Fig. 1). Larvae eclose five to six days after oviposition.

The egg bursters are forced into the egg shell by pressure created from the dorsal side of the abdominal segments pushing against the egg shell. Once this process is started, it takes only a minute or so for the larva to eclose. It is of interest to note that none of the three aforementioned *Lebia* have been shown to have egg bursters; however, I suspect that these projections are present in at least some of these species, but simply have been overlooked.

As in other *Lebia* larvae studied to date, the first instar larvae of *L. viridis* are typical appearing carabid larvae that actively search for a host pupa immediately after eclosion. Once found, the larva crawls over the pupa and around the pupal cell. This may allow the larva to attach to a suitable area of the pupa. Nearly all feeding that I observed began laterally on the first few abdominal segments of the host pupa. This may be the area of the host from which the larva is least likely to be shaken off, such as the prosternum is for *Brachinus pallidus* (Erwin 1967). The larva consumes the entire host pupa in two to three days at room temperature and becomes greatly distended by the time its meal is finished. Then the larva is relatively inactive for one to two days before it molts to a second instar. The second instar remains inactive for four to five days at room temperature before pupating within the host's pupal chamber.

At room temperature the pupal stage of *L. viridis* develops in four to six days. The pupae are yellow, as are the pupae of the host. The mandibles, eyes, and the dorsal aspect of the posterior abdominal segments darken first. Newly emerged adults are yellow before becoming pigmented within a day or so. Typically, hardening of the cuticle requires about one week. Teneral adults are metallic blue and gradually turn color to a metallic green some time after the cuticle hardens.

Seasonal Abundance of *L. viridis* and *A. foliacea*

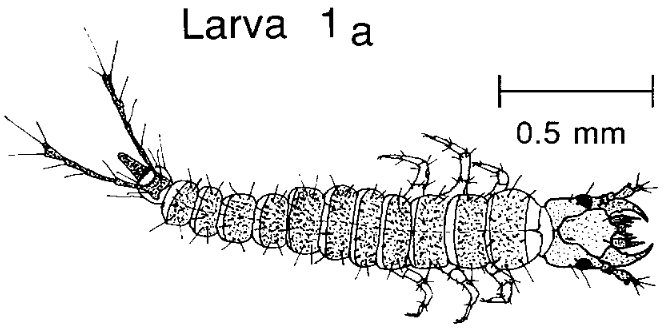
Weekly observations from September through November at the *O. biennis* study site showed that the highest densities of *A. foliacea* adults occurred during mid-September and approximated five beetles per plant. Densities of *L. viridis* did not exceed one per ten plants. All *L. viridis* seen (n = 6) were metallic green.

Observations from April through June at the *O. lacineata* patch in the study site showed that the peak densities of *A. foliacea* larvae occurred in late April and early May. Adult *A. foliacea* sustained high densities from late April through June. Densities of *L. viridis* were highest in early and mid-May with densities approaching one per plant. On May 10, 1988, 50 *L. viridis* were sighted in *ca.* a 10 by 60 m area. Of these, 41 were metallic blue and nine were metallic green. On June 12, 1988, five *L. viridis* were sighted in the same area and all of these were green.

Description of Immature *Lebia viridis* Say

The larvae undergo a simple form of hypermetamorphosis. The first instar larva resembles the typical carabid larva. The second instar larva has reduced appendages, only faint scleritization, and a distended body; it does not resemble the typical carabid larva.

FIRST INSTAR LARVA BEFORE FEEDING (Larva 1_a, Figs. 2, 7, 10–13). Size variable, but mostly between 1.8–2.0 mm long from tips of antennae to tips of urogomphi. Head



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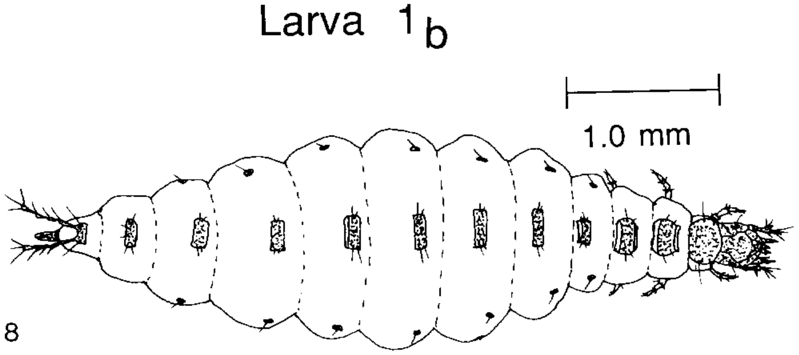

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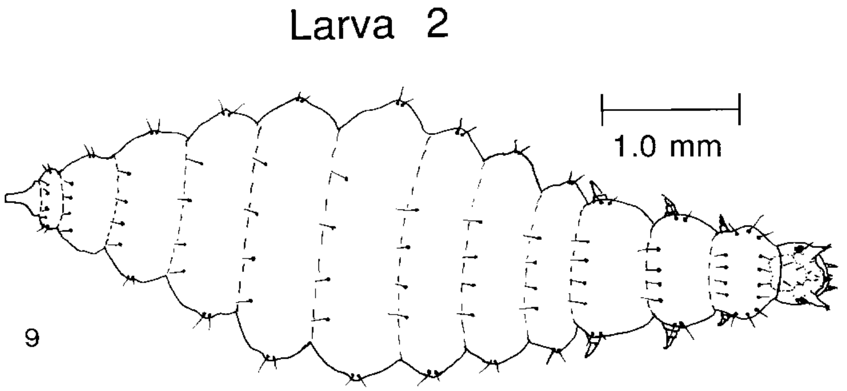

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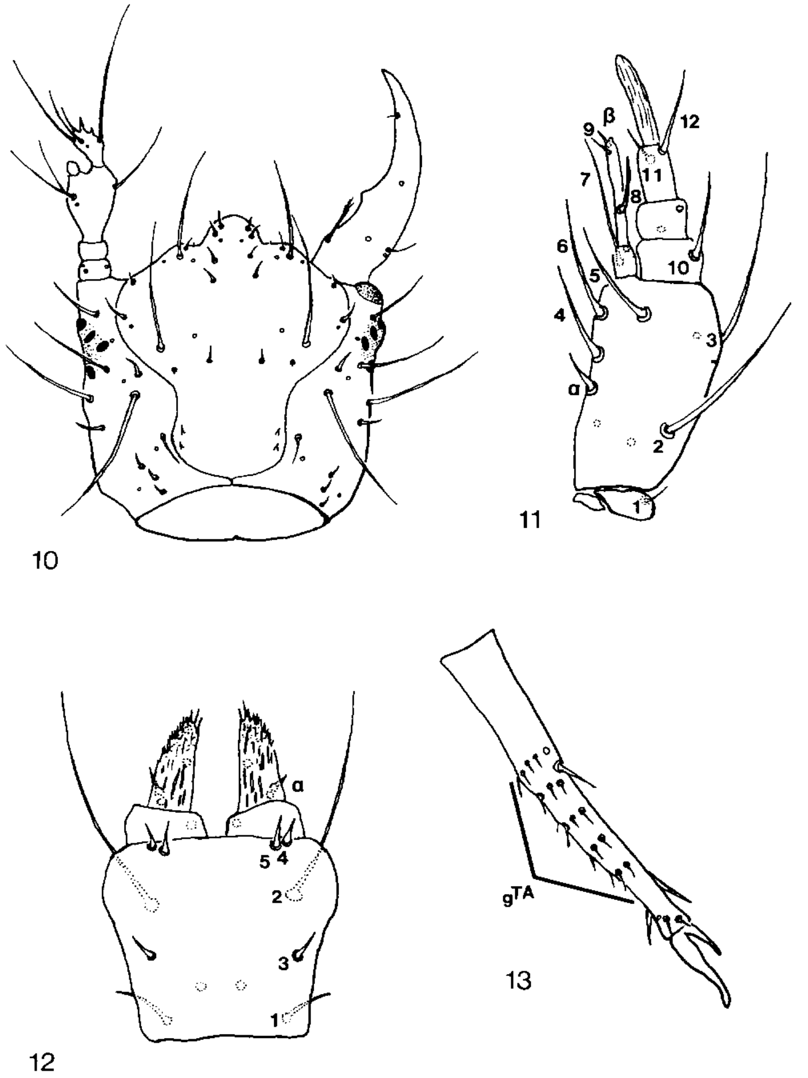
Figs. 7–9. *Lebia viridis*. 7, first instar larvae before feeding. 8, first instar after consuming one *Altica foliacea* pupa. 9, second instar larva.

distinctly sclerotized, thoracic and abdominal segments each with distinct pigmented sclerites. Terga entire. *Measurement:* head width, 0.26–0.31 mm (n = 10). *Chaetotaxy:* all ancestral setae and pores match ancestral pattern inferred by Bousquet and Goulet (1984) except for following: LA_6 absent; PR_j absent; ME_c and ME_f of both meso- and metanotum absent; TE_5 of tergite I absent; TE_a and TE_b of tergites I, II, IV, V, VI, VII, and VIII absent; TE_b of tergite III absent. Labium with additional seta (LA_α) located



Figs. 10–13. *Lebia viridis*, first instar larva. 10, head, dorsal view. 11, maxilla, dorsal view. 12, labium, dorsal view. 13, tarsus, lateroventral view with anterior portion to right. Setae numbered and lettered following Bousquet and Goulet 1984.

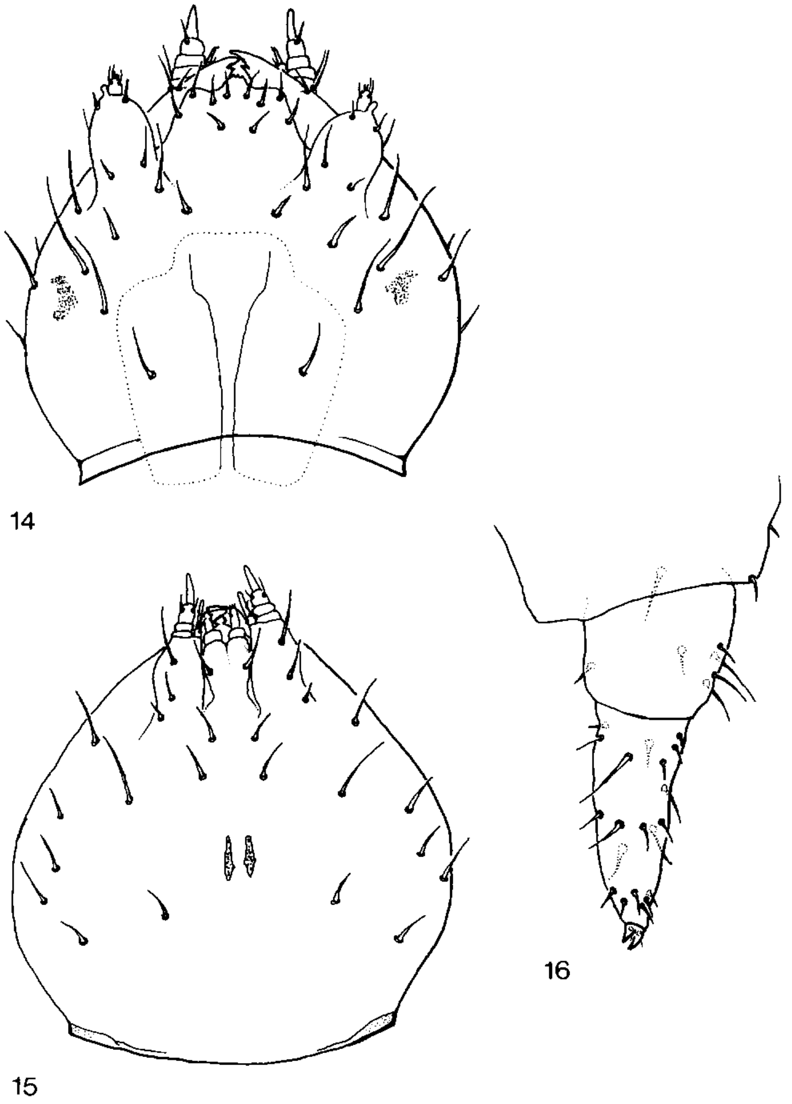
lateroventrally on labial palpomere 2 (Fig. 12). Setae LA_3, LA_4, and LA_5 reduced in length. Stipes with additional seta (MX_α) located posterior to MX_4. Galea with additional seta (MX_β) located anterior to MX_9 (Fig. 11). Seta TE_7 longer than TE_9 on tergites I–VIII. Tarsus with an additional anteroventral setal group (gTA) with 15–18 setae (Fig. 13). *Head* (Fig. 10): subquadrate, slightly wider than long, sides subparallel; epicranial suture broadly U-shaped, but compressed along posterior third of frontal sclerite, latter not extended to posterior margin of the head capsule; coronal suture short, about 0.2×

as long as antennomere 4; nasale with central rounded lobe; adnasale small and rounded; egg bursters consisting of two pairs of spines posteriorly on frontal sclerite near epicranial suture. Eyespots consisting of four stemmata on each side, three in anterior row and one in posterior row. Antenna subequal to length of mandible; four articles; antennomere 3 longest, with auxilary process and one lateroventral mammillate sensory papilla; antennomere 4 bearing three terminal sensory papillae—one lateral, digitate, medium length—one medial, spine-like, longest—one mesal, mammillate, shortest. *Mouthparts* (Figs. 10–12): mandible markedly falciform, blade smooth, retinaculum small, penicillus prominent. Maxilla with basal cardo, stipes about 2× as long as wide, galea of two articles, and palpus of four articles: lacinia absent; galea as long as palpomeres 1–3 combined; galeomere 2 with two terminal mammillate papillae. Labium without ligula; palpomere with two articles, palpomere 2 setulose. *Thorax:* prothorax, mesothorax, and metathorax each with pigmented entire terga and pair of pleura. Prothorax larger than meso- or metathorax, slightly wider than head, *ca.* equal to length of head. *Legs:* legs longer than width of corresponding thoracic segment, each with five articles; article 5 with two unequal claws. *Abdomen:* ten-segmented, each with pigmented tergum, sternum, and pair of pleura; terga and pleura entire. Sterna I–VII each divided into seven sternites: one central, two anterior to the central sternite, other four aligned in lateral row posterior to central sternite. Segment IX with pair of urogomphi, slightly longer than legs, and each of four articles: article 4 with lateral lobe. Pygidium unsegmented, triangular; length about 0.25× that of urogomphi.

FIRST INSTAR LARVA AFTER FEEDING (Larva 1_b, Figs. 3, 4, 8). Length *ca.* 4–6 mm. Identical to larva 1_a except: body greatly distended (*cf.* Figs. 7, 8) and *ca.* twice as long; larva 1_b relatively immobile (possibly because of great weight gain incurred during feeding).

SECOND INSTAR LARVA (Larva 2, Figs. 5, 9, 14–16). Same characteristics as the first instar except for following. Length *ca.* 4–6 mm, cream colored except much darker eyespots and tips of mandibles. Body not sclerotized except faintly on head capsule; quite soft. Locomotion limited. *Measurement:* head width, 0.42–0.57 mm (n = 9). *Chaetotaxy:* Setae MX_α and gTA absent. Setae UR_4–UR_9 and pores UR_a–UR_g absent. Legs with all setae and pores of first instar (fused tarsus, tibia, and femur with all primary setae of these three articles) (*cf.* Figs. 13, 16). Venter of abdominal segments I–VII each with secondary seta found near ST_5 and ST_6. *Head* (Figs. 14, 15): form rounded, teardrop shaped, more prominent (compared to body) than head of larva 1_b; faint medial sclerite extending from cervix to *ca.* half the distance to tip of mandibles and extended posteriorly into pronotum; nasale with central rounded, faintly serrate, lobe with pair of mammillate papillae anterior to seta FR_{11}; adnasale small and rounded. Egg bursters absent. Eyespots consisting of four dark lateral spots on each side (may shift posteriorly with maturation of larva), clearly defined stemmata absent. Antenna equal in length to mandible; two articles; antennomere 1 massive, with lateral auxilary process; antennomere 2 much smaller, with three terminal papillae—one lateral spine-like, longest—one medial, digitate, subequal to lateral papillae—one mesal, mammillate, shortest. *Mouthparts:* mandible: length and curvature much less compared to mandible-head length ratio and curvature of first instar larvae; blades with teeth (larger in mature than in young larvae); retinaculum sharp, smooth. Maxilla: cardo fused to long, thick stipes; galea with two articles, galeomere 2 with three subequal terminal mammillate papillae; palpus with four articles. *Thorax:* metathorax wider than mesothorax, latter wider than prothorax, and prothorax wider than head capsule. *Legs* (Fig. 16): shorter than corresponding thoracic segments, each with three articles and numerous pores; article 1 coxa; article 2 trochanter; article 3 fused femur, tibia, and tarsus. *Abdomen:* ten-segmented, each segment *ca.* same size as corresponding segment from larva 1_b; sclerotization not evident. Each segment with ventral lobes, each with two or three setae. Segment IX with two small projections (remnants of urogomphi). Pygidium shorter than that of larva 1.

PUPA (Fig. 6). Length *ca.* 3–4 mm, from pronotum to tip of abdomen. Cream colored when young, but gradually yellowing before emergence; mandibles, eyes, and dorsal aspect of the posterior abdominal segments darken first. *Measurement:* head width, 0.76–0.82 mm (n = 3). *Position of head and appendages:* head tucked beneath pronotum and



Figs. 14–16. *Lebia viridis*, second instar larva. 14, head, dorsal view. 15, head, ventral view. 16, right mesothoracic leg, laterodorsal view.

between fore and middle legs. Antenna extends beneath eye, underneath fore and middle legs, then parallel to mesotibia. Maxillary palpi, antennal apices, and all tarsi directed toward midline of abdominal venter. Wing pads beneath middle and hind legs. *Setation:* head with six pairs of supraorbital setae. Dorsum of prothorax with two transverse rows of long setae. Dorsum of meso- and metathorax, and all abdominal segments each with two transverse rows of setae: anterior one with short setae; posterior one with longer setae. *Abdomen:* eight-segmented, with segment VII much longer than any other segment.

DISCUSSION

Population Biology

It seems unlikely that *L. viridis* larvae are monophagous given the published associations (Isely 1920; Hemenway and Whitcomb 1967; Lindroth 1971). It is possible, as Madge (1967) suggested, that different alticid hosts are used in different geographical areas by different forms of *L. viridis.* If so, I expect the form or forms of *L. viridis* present in those geographic areas containing sympatric host alticids to have multiple hosts. I have presented observations of *L. viridis* larvae associated with *A. foliacea* in northern Florida; investigations of other possible associations are underway.

All teneral adults observed were metallic blue and became metallic green as they matured. This color change appears to be a good indicator of new generations of *L. viridis.* As noted above, metallic blue beetles were observed in the field during the spring only, indicating that *L. viridis* is a spring breeder. The fact that no eggs were laid by fall females, which were paired with fall males in the laboratory, supports this claim.

Relationship to Other *Lebia* Species

In Madge's (1967) revision of the genus *Lebia* in North America, *L. viridis* is placed in the subgenus *Lebia* along with 36 other species. However, Lindroth (1969:1016) expressed uncertainty of the representation of the true subgenus *Lebia* in North America. He stated that Madge's *Lebia* (*s. str.*) corresponds to the subgenus *Poecilothais* Maindron as applied to the Japanese fauna. He also disagreed with Madge's evaluation of the infraspecific forms of *L. viridis.* He recognized *L. moesta* LeConte as a valid species, and supported his opinion with data.

The present study supports the first of Lindroth's contentions by the following differences between *L. viridis* and *L. scapularis* larvae: 1) *L. viridis* does not form the cocoon or have a prepupal instar such as is found in *L. scapularis* and 2) all thoracic and abdominal terga of *L. viridis* are entire while those of *L. scapularis* are divided into two tergites. These differences are substantial; however, since it is not known if the character states from which these differences arise are primitive (symplesiomorphic) or derived (apomorphic), separation of these two species into separate subgenera is unwarranted (Ax 1987).

From Lindroth's (1954) limited account of *L. chlorocephala,* it appears that *L. viridis* larvae are morphologically more similar to those of *L. chlorocephala* than to those of *L. scapularis.* In fact, no major differences were found between *L. viridis* and *L. chlorocephala* larvae (other than size). As Lindroth (1954) noted for *L. chlorocephala,* the entire terga in *Lebia* invalidate the couplet to the genus *Lebia* in van Emden's (1942) key to the genera of larval Lebiini.

From Chaboussou's (1939) more detailed account of *L. grandis,* one difference (other than size) is found between *L. viridis* and *L. grandis*: the frontal sclerite of *L. viridis* does not reach the posterior margin of the head, but does so in *L. grandis.*

Since setae and pores are not examined thoroughly in any of the previously studied *Lebia* larvae, I am unable to compare setal patterns of these species to *L. viridis.* This is unfortunate, because some authors, including myself, believe that these larval characters show potential for testing and improving the classification of Carabidae (Bousquet and Goulet 1984).

If all *Lebia* larvae are ectoparasitoids, it is reasonable to believe that their larvae must share synapomorphies which allow them to better pursue this ectoparasitic way of life. However, there must be some apomorphies present in this group, if for no other reason, because of its great diversity. It is these apomorphies that must be found to test the current subgeneric groupings which are based on adult characters. This paper suggests that *L. viridis* and *L. scapularis,* which were both placed in the subgenus *Lebia* via adult characteristics, may be less closely related than previously thought. To test and improve our knowledge of *Lebia* more complete larval descriptions including documentation of setae are necessary. These descriptions will not only improve our knowledge of *Lebia* but, because of *Lebia*'s unique life style, will improve our knowledge of evolution.

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BOOK REVIEW

CASALE, A. 1988. **Revisioni degli Sphodrina (Coleoptera, Carabidae, Sphodrini).** Monografie V. Museo Regionale di Scienze Naturali, via Maria Vittoria 18, Torino (Italy). 1024 pp. Price: 90,000 Italian lire (about US$65.00).

This book appears to be a very important contribution to the knowledge of the Sphodrini, although the study is limited to the so-called "True Sphodrids," which constitute an homogeneous and difficult group of closely related species and species-groups.

The book is divided into five parts; the most important part is devoted to the systematic study of all the 269 known species and represents about ⅚ of the pages. Descriptions, with many good and precise drawings, will be very useful for the identification of the species, although in many cases, the use of sexually dimorphic characters leads to difficulties in determination, even genus determination, and one would need a preliminary knowledge of the group to succeed in bypassing these difficulties.

In the systematics part, a few pages are devoted to the position of the group within the Carabidae, and a suprageneric study is presented. Although a few points are to be considered as unlikely, such as *Synuchidius* being placed close to *Synuchus* (only in a table), or importance given to the presence of apical setae of female gonocoxites, it looks more like a new presentation for a classical approach than a new approach of the problem. A more complete and critical analysis of the proposed dendrogram will be best presented elsewhere together with a synthetic study of all the systematic arrangements proposed for the tribe.

The other four parts are much more reduced. The Introduction, Morphology, and Bionomics, which are little developed, show the need of more studies in this field, and the Biogeography part appears rather light.

Altogether, Pr. Casale performed a very good study, and his book will become a library must for all scholars interested by Sphodrini.

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The Coleopterists Bulletin, 43(2):195–202. 1989.

THE LARVAE OF *NEOSCUTOPTERUS* J. BALFOUR-BROWNE (COLEOPTERA: DYTISCIDAE), WITH NOTES ON LARVAE OF OTHER COLYMBETINI[1]

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ABSTRACT

Third instar larvae of *Neoscutopterus hornii* (Crotch) and *N. angustus* (LeConte), which typically inhabit boreal swamps, are described and compared with larvae of other Colymbetini. While *Neoscutopterus* larvae are so similar to those of *Colymbetes, Rhantus,* and *Hoperius* that they are immediately recognized as Colymbetini, many substantial differences readily separate them from these genera. Their deeply emarginate labium and lack of small basoventral spines on the tarsal claws separate them from sympatric *Colymbetes* and *Rhantus* and suggest that they may be more closely related to the southern genus *Hoperius,* which shares these features.

Neoscutopterus and *Carrhydrus* are the only Colymbetinae that are not included in generic keys to larvae of North American Dytiscidae. Both species of *Neoscutopterus, N. hornii* (Crotch) and *N. angustus* (LeConte), occur only in boreal North America; their larvae, like those of most species of North American Colymbetinae, have remained unknown. Below I describe larvae of both species in sufficient detail to separate them from each other and from two sympatric species of Colymbetini that they most resemble. I also indicate how they differ from other Colymbetini, amend the generic key by White *et al.* (1984), and tell why they cannot be larvae of any other species of Colymbetini that occur in Wisconsin. Although neither species has been reared, I am describing the larvae so that the genus may be recognized and larvae reared to confirm my tentative species identifications. Larvae are difficult to collect alive because they live in *Sphagnum,* and I have collected them only in bottle traps. One recent effort to rear *N. hornii* failed, possibly because *Sphagnum* was not provided for pupation.

Except for the monotypic *Hoperius planatus* Fall, which was described in detail by Spangler (1973), most North American Colymbetini larvae cannot be identified to species with certainty. Of the 7 species of North American *Colymbetes* (Zimmerman 1981), only the larva of *C. sculptilis* Harris has been described from North America (James 1969; Watts 1970); the larva of holarctic *C. dolabratus* Paykull was briefly described from Europe (Galewski 1968). Larvae of the 10 species of *Rhantus* (Zimmerman and Smith 1975) are just as poorly known, with only those of *R. binotatus* (Harris) and *R. frontalis* (Marsham) having been described from North America (James 1969; Watts 1970, respectively); larvae of holarctic *R. suturellus* (Harris) are known from Europe (Galewski 1963).

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MATERIAL EXAMINED AND MEASUREMENTS

Habitat records for adult and larval Colymbetini collected throughout Wisconsin were examined. Adults included 18 *Neoscutopterus angustus,* 74 *N. hornii,* 25 *Colymbetes exaratus* LeConte, 157 *C. paykulli* Erichson, 2,685 *C. sculptilis,* 330 *Rhantus binotatus,* 667 *R. consimilis* Motschulsky, 3 *R. frontalis,* 30 *R. gutticollis* (Say), 44 *R. sinuatus* (LeConte), 45 *R. suturellus,* and 104 *R. wallisi* (Hatch). Almost 98% of *Neoscutopterus* adults and 83% of their larvae were collected from spruce-tamarack (*Picea mariana–Larix laricina*) swamps. The only other species of Colymbetini that typically was found in this habitat was *C. paykulli* (all collections from May through August–2 larvae, 13 adults).

Third instar Colymbetini larvae from Wisconsin that were studied included 23 *N. hornii,* 1 *N. angustus,* 145 *C. sculptilis,* 2 *C. paykulli,* and 305 *Rhantus* spp. Also studied were several earlier instar larvae, 2 third instar *C. paykulli* from Sweden, and 1 third instar *H. planatus* from Maryland. Third instar Colymbetini have prominent spiracles anterolaterally on the mesosternum and laterally on the first 7 abdominal terga; earlier instars lack these functional spiracles (Nilsson and Cuppen 1988).

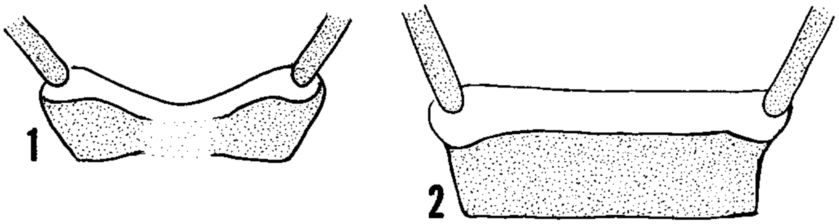
Larvae of *C. sculptilis* were readily identified from descriptions by James (1969) and by their relationship to adults in ponds in southern Wisconsin; those of *C. paykulli* were identified by comparing them with specimens from Sweden that were identified by Anders Nilsson as part of a recent study of European *Colymbetes* (Nilsson and Cuppen 1988). Larvae of *Rhantus binotatus* and *R. frontalis* were identified from descriptions by James (1969) and Watts (1970), respectively. Based on differences in head capsule width, spination on the urogomphi, and relative length of urogomphi, larvae of at least 3 other species of *Rhantus* were recognized but not identified.

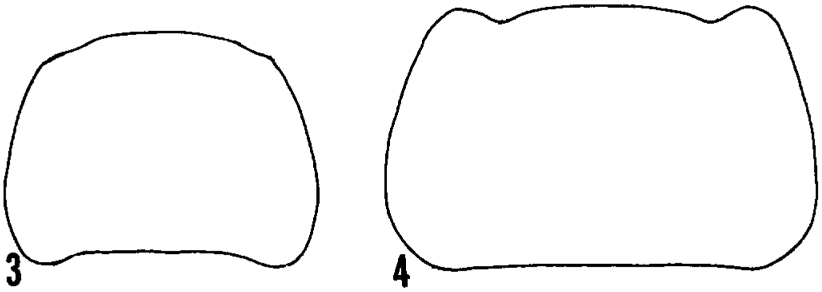
Head capsule width (HCW) of all larvae was measured using a dissecting microscope with an ocular reticle. Additionally, length of each antennal segment, each palpal segment, and basal width and length of mandibles were measured on selected third instar larvae as follows: *N. angustus,* 1; *N. hornii,* 11 (1 from each collection); *C. paykulli,* 4 (2 from Sweden); *C. sculptilis,* 6 from geographically diverse collections; *Rhantus,* 3 of each species (1 *R. frontalis*). Spination on the legs of several larvae of each species of *Neoscutopterus* and *Colymbetes* was also studied to detect differences. Total length (excluding urogomphi), length of abdominal segment 8, and length of urogomphi were measured on all *Neoscutopterus* and many *Colymbetes* and *Rhantus.* Integument from the fourth abdominal sternum of each species was mounted in Hoyer's medium on a microscope slide for examination with a compound microscope.

Third Instar *Neoscutopterus hornii* Larvae

GENERAL. Length without urogomphi 18.1–23.3 mm; HCW 2.6–3.0 mm ($\bar{x} = 2.9$); color very dark reddish brown, with markings obscure except for a pair of yellow spots on head just posterior to arms of epicranial suture; markings may be more distinct on teneral specimens.

HEAD. Not keeled laterally, with 5–8 temporal spines; labium deeply emarginate anteriorly and with ventral surface imperceptibly sclerotized mesally (Fig. 1); mandibles elongate, length/basal width ratio 3.37–4.00 ($\bar{x} = 3.64$); fourth antennal segment about ¾ length of third, first antennal segment about ¾ length of second; maxillary stipes about ¼ length of palp; distal segment of labial palp relatively long, 0.72–0.84 × length of basal segment ($\bar{x} = 0.78$).





Figs. 1, 2. Labium, ventral view. 1, *Neoscutopterus hornii*. 2, *Colymbetes paykulli*.
Figs. 3, 4. Outline of pronotum, dorsal view. 3, *Neoscutopterus hornii*. 4, *Colymbetes paykulli*.

THORAX. Outline of anterior margin of pronotum evenly curved in dorsal view (Fig. 3); margin of pronotum extending laterad of prosternum 0.2 mm wide.

LEGS. Tarsal claws without basoventral spines; protarsus with 8–10 anteroventral (inner ventral) spines and 7–9 posteroventral spines; metatibia with at most one median ventral seta longer than width of tibia.

ABDOMEN. Urogomphi short, 0.58–0.74 × length of abdominal segment 8 ($\bar{x} = 0.66$); abdominal sterna 1–6 with conspicuous, brown, spine-like setae separated by about length of a seta, and covered with numerous spinules about twice as long as their basal width (Fig. 8).

HABITAT. Seventy-two adults and 18 larvae were collected from among *Sphagnum* in spruce-tamarack swamps. One additional adult was trapped April 19 about 1 km from a swamp in a marsh containing *Sphagnum*, and 1 adult and 5 large larvae were trapped March 30–April 6 in a flooded *Carex* marsh adjacent to a drainage ditch.

Third Instar *Neoscutopterus angustus* Larva

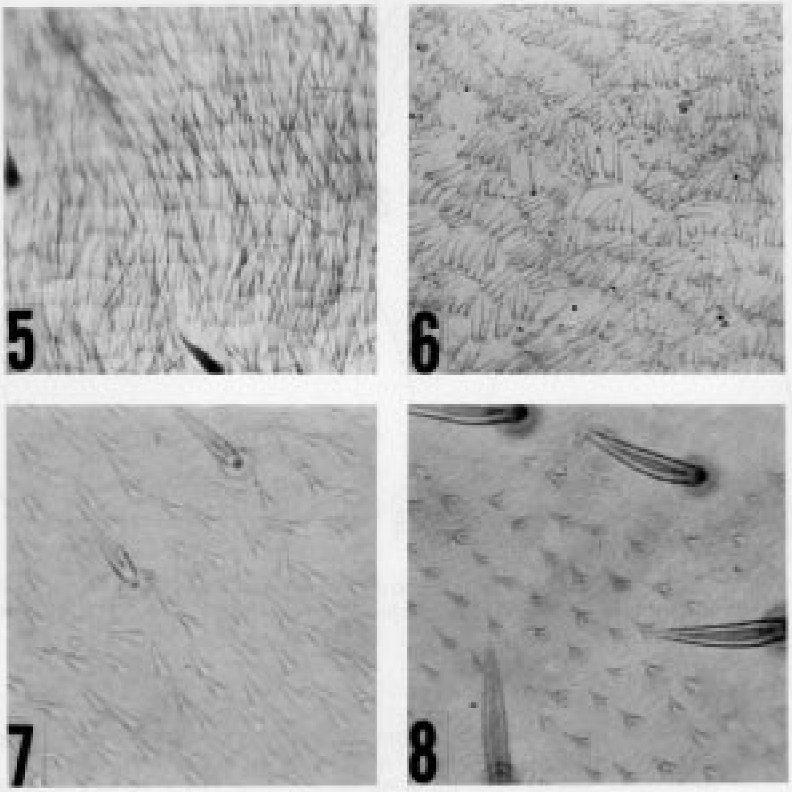
One teneral larva appeared the same as *N. hornii* except as follows.

GENERAL. Length 18.9 mm; HCW 2.8 mm.

HEAD. Mandibles very elongate, length 4.0 × basal width; distal segment of labial palp relatively very long, 0.87 × length of basal segment.

LEGS. Each metatibia with 2 median ventral setae longer than width of tibia.

ABDOMEN. Urogomphi 0.83 × length of abdominal segment 8; abdominal sterna 1–6 with inconspicuous spine-like setae separated by about 2–3 times their length, and



Figs. 5–8. Photomicrographs (250×) of fourth abdominal sternum of third instar larva. 5, *Colymbetes paykulli*. 6, *C. sculptilis*. 7, *Neoscutopterus angustus*. 8, *N. hornii*. Width of each square = 0.12 mm.

numerous spinules about 4 times as long as their basal width (Fig. 7). The spine-like setae may have been pale because the larva was teneral.

HABITAT. All 18 adults and the single larva were trapped from *Sphagnum* in spruce-tamarack swamps in northern Wisconsin. Most were in swamps with fewer trees than those typically inhabited by *N. hornii*, but *N. hornii* also occurred in two-thirds of the swamps from which *N. angustus* was collected.

IDENTIFICATION OF SPECIES OF *NEOSCUTOPTERUS*

Larvae of *N. hornii* can be readily separated from *N. angustus* by their distinctly shorter urogomphi and relatively longer basal segment of the labial palp (Table 1). They also have at most 1 long ventral seta on the metatibia, never 2 as in the only larva of *N. angustus*. Examination of slide-mounted integument from abdominal sterna at 250× revealed that *N. hornii* has shorter spinules and more closely spaced spine-like setae (Figs. 7, 8).

Species names were tentatively assigned to the two species mostly because

Table 1. Comparison of third instar larvae of *Neoscutopterus hornii*, *N. angustus*, *Colymbetes paykulli*, and *C. sculptilis*.

	N. hornii	*N. angutus*	*C. paykulli*	*C. sculptilis*
Head capsule width	2.6–3.0 mm	2.8 mm	3.5–3.7 mm	3.0–3.4 mm
Anterior of labium (Figs. 1, 2)	emarginate	emarginate	truncate	truncate
Length maxillary stipes/palps	0.27	0.25	0.30	0.34
Mandible length/basal width	3.6	4.0	2.7	2.7
Segments labial palp (mm ×4)	2.7–2.1	2.3–2.0	3.4–2.2	3.1–2.1
Antennal segments (mm ×4)	1.8:2.4:2.1:1.6	1.8:2.4:2.2:1.7	2.4:2.5:2.3:2.1	2.1:2.4:2.3:2.1
Temporal spines	5–8, no ridge	6–7, no ridge	8–12 on ridge	8–10 on ridge
Width pronotal margin	0.2 mm	0.2 mm	0.4–0.5 mm	0.4–0.5 mm
Anterior of pronotum (Figs. 3, 4)	curved	curved	bisinuate	bisinuate
Spines on tarsal claws	absent	absent	present	present
Protarsus anteroventral spines	8–10	9	6, 7	5–7
Protarsus posteroventral spines	7–9	8	4, 5	2, 3
Abdominal sterna 1–6 (Figs. 5–8)	spinules	spinules	pubescence	pubescence
Setae abdominal sterna 1–6	spine-like	spine-like	dark, fine-tipped	none
Urogomphi/abdominal segment 8	0.66 (0.58–0.74)	0.83	1.02 (0.97–1.09)	1.03 (0.97–1.07)

of the relationship of larval maturity to occurrence of teneral adults. In Alberta, Larson (1975) collected teneral *N. hornii* July 10 to August 8 and slightly teneral *N. angustus* May 17, which he believed had emerged the previous fall. In Wisconsin, where the climate is warmer, teneral specimens were collected earlier; teneral *N. hornii* were collected June 20 and 23 and 6 teneral *N. angustus* were collected August 16 to 21. Eight third instar *N. hornii* larvae that were collected in early April were very large and would probably have pupated when temperatures warmed, which correlates with emergence of *N. hornii* in June. The 14 third instar *N. hornii* larvae that were collected in mid-August were well-sclerotized and larger than the teneral *N. angustus* larva that was collected at the same time and logically would pupate earlier the following summer than *N. angustus* as collections of teneral adults indicated. Also, 7 collections of *N. hornii* larvae were from swamps where adults of only that species were found; none were collected from swamps where only *N. angustus* adults were found. This, and the much greater abundance of larvae of the more abundant *N. hornii,* are further evidence to support my assignment of species names.

Collected along with third instar larvae in mid-August were 2 second instar larvae that I believe are *N. hornii* because of their short urogomphi (0.72× length of abdominal segment 8) and 4 first instar larvae. This strongly indicates that both species, which develop in very cold water, have life cycles of two or more years.

Differences between third instar larvae of *Neoscutopterus* and 2 sympatric and similar sized species of *Colymbetes, C. paykulli* and *C. sculptilis,* are summarized in Table 1. Larvae of *Neoscutopterus* differ substantially from these species and also from the 5 boreal *Rhantus* species collected in Wisconsin by lacking small basoventral spines on the tarsal claws, and by having a deeply emarginate instead of truncate labium (Figs. 1, 2), longer mandibles, unkeeled margin of the head, much narrower pronotal margin, evenly curved anterior of the pronotum (Figs. 3, 4), and short spinules on abdominal sterna 1–6 instead of pubescence (Figs. 5–8). *Neoscutopterus* larvae more closely resemble *Hoperius planatus* larvae, which also have an emarginate labium, very long mandibles (4.27× basal width), a relatively narrow margin on the pronotum (0.2 mm), and lack small basoventral spines on the tarsal claws. *Hoperius planatus* is a monotypic southern species that occurs north to Arkansas and Maryland (Spangler 1973), far south of the range of *Neoscutopterus. Neoscutopterus* larvae differ most substantially from those of *Hoperius* by having longer labial palps that are subequal to or longer than antennal segments 1–2 (0.7× in *Hoperius*), a broad maxillary stipes that is only about 2× as long as wide (4× in *Hoperius*), short spinules (2–4× basal width) on abdominal sterna 1–6 [elongate spinules (7× basal width) in *Hoperius*], and tear-shaped instead of semicircular anterior sclerites on the prosternum. Larvae of *Neoscutopterus* will key to *Hoperius* in White *et al.* (1984), but can be separated by modifying couplet 16 as follows.

16(15′). Tarsal claw with small spines on lower margin in basal half; labium truncate apically 17
16′. Tarsal claw without small spines on lower margin in basal half; labium deeply emarginate apically 16a
16a(16′). Basal segment of labial palp much shorter than maxillary stipes; southern United States .... *Hoperius*
16a′. Basal segment of labial palp much longer than maxillary stipes; boreal United States and Canada .... *Neoscutopterus*

IDENTIFICATION OF LARVAE OF *COLYMBETES, RHANTUS,* AND *NEOSCUTOPTERUS*

Third instar larvae of North American *Rhantus* and *Colymbetes* cannot be reliably separated by mandibular length (key by White *et al.* 1984), or by length of the maxillary stipes (keys by Galewski 1973; Nilsson 1982). However, they can be separated by differences in size in regions where the small Arctic race of *Colymbetes dolabratus* (Paykull) and the two large southern *Rhantus* [*R. atricolor* (Aubé) (NM, AZ, TX, Mexico) and *R. calidus* (Fabricius) (coastal from NY to Mexico] do not occur. Third instar Wisconsin *Colymbetes* were readily separated from *Rhantus* by HCW (3.0 mm or more in *Colymbetes,* 2.6 mm or less in *Rhantus*), and this character can probably be used to separate all boreal *Rhantus* from *Colymbetes.* Additionally, all *Rhantus* larvae from Wisconsin have short, thick, spinose setae on the urogomphi. Two species had only one such seta ventrolaterally in about the basal third of each urogomphus, but the other 3 species had several such setae laterally and dorsally. Neither *C. sculptilis* nor *C. paykulli* larvae have thick spinose setae, although they often have some setae that are short.

The larvae that were identified as *Neoscutopterus* are obviously Colymbetini, which are readily distinguished by their relatively large size (third instar), secondary setae on the urogomphi, lack of a setal fringe on abdominal segments 7 and 8, and long fourth antennal segment. They are definitely *Neoscutopterus* and not some other species of Colymbetini for the following six reasons.

1. *Neoscutopterus, Rhantus,* and *Colymbetes* are the only genera of Colymbetini that could occur in Wisconsin based on adult collections and published distributions. Larvae of all other Colymbetinae genera that could occur in Wisconsin are known, and none resemble the larvae identified as *Neoscutopterus.*

2. It is not possible that larvae of any boreal *Rhantus* species could be as large as larvae identified as *Neoscutopterus.* Measurements by Larson (1975) in Alberta showed that the mean length of adults of the smallest species of *Neoscutopterus* is 43% longer than the largest species of boreal *Rhantus.* These are the same species of *Rhantus* that occur in Wisconsin where most third instar larvae were 12–14 mm long (excluding urogomphi), and the largest larva did not exceed 16.0 mm; third instar *Neoscutopterus* larvae were 18.1–23.3 mm long and second instars were about the same length as *Rhantus* (13.0–14.5 mm).

3. Larvae of 2 of the 3 species of *Colymbetes* known to occur in Wisconsin have been identified. Adults of the third species, *C. exaratus,* have been collected only in areas of western and southern Wisconsin where *Neoscutopterus* has not been found. The only other species of *Colymbetes* that could possibly occur in Wisconsin is *C. dahuricus* Aubé, which has a much more northern and western distribution (Zimmerman 1981). *Colymbetes exaratus* adults are extremely similar to those of *C. sculptilis,* and adults of *C. dahuricus* are very similar to those of *C. paykulli* (Zimmerman 1981), so it is probable that their unknown larvae are also very similar. Since larvae of 2 of the most different species of *Colymbetes, sculptilis* and *paykulli* (Zimmerman 1981), and at least 5 species of *Rhantus* all share several characters by which they differ significantly from larvae identified as *Neoscutopterus,* and since larvae of the 4 European species of *Colymbetes* are all "very similar" and have a "striking similarity" to *Rhantus* (Nilsson and Cuppen 1988), it is inconceivable that the larvae identified as *Neoscutopterus* could possibly be some other species of *Rhantus* or *Colymbetes.*

4. Almost all larvae and adults of *Neoscutopterus* were collected from *Sphagnum*. Except for *C. paykulli*, which is known in both the larval and adult stages, no other species of Colymbetini in Wisconsin had an affinity for spruce-tamarack swamps. Rarely, collections of adults or larvae of *C. sculptilis* and some species of *Rhantus* were from this habitat. This was also the situation in Alberta (Larson 1975), where all of the same species of Colymbetini, except *R. gutticollis*, also occur.

5. Most third instar *Neoscutopterus* larvae were collected in August; some mature larvae that had overwintered were collected in early April. No third instar *Colymbetes* larvae have ever been collected in Wisconsin before April 17 or after June 19.

6. All summer collections of *Neoscutopterus* larvae were in association with *Neoscutopterus* adults of the same species and never in association with adult *Colymbetes*.

ACKNOWLEDGMENTS

I thank Dr. Paul Spangler of the Smithsonian Institution for sending me a larva of *Hoperius planatus* to compare with larvae of *Neoscutopterus* and Dr. Anders Nilsson, Umeå University, Sweden, for sending me larvae of *Colymbetes paykulli* for comparison with Wisconsin larvae.

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SCIENTIFIC NOTE

Elenchus koebeli (Pierce) (Elenchidae): First Record of Strepsiptera from the Galapagos Islands, Ecuador[1]

Strepsipterans are unusual endoparasitic insects that have been classified as a family of beetles or as a group of families forming an order. They may be the sister group to the beetles (see Kristensen 1981; Lawrence and Newton 1982).

The distributions of the species of strepsipterans are poorly understood because of the difficulties in collecting specimens. We have used ultra-violet light traps and flight intercept traps to catch fair numbers of strepsipterans in subtropical and tropical New World habitats. Use of these methods showed the presence of a species of strepsipteran in the Galapagos Islands. Over a thousand insect species in 23 orders are now known from the Galapagos, but strepsipterans have not been previously reported (Linsley and Usinger 1966; Linsley 1977).

Our specimens have the following collection data: Galapagos Islands, Ecuador: Isla Santa Cruz, 4 km N Bellavista, Media Luna, 620 m, 14.V–13.VII.1985, S. & J. Peck, *Miconia* vegetation zone, malaise-flight intercept trap (1 in trap trough, 1 in malaise head, in S. Peck collection). Isla Isabela, Sierra Negra, 15–27.IV.1986, S. Abedrabbo, 1 in intercept trap in burned area; 1 in intercept trap in unburned control area (specimens in Entomology Collection of Catholic University, Quito, Ecuador).

Determination of the material showed that they are in the family Elenchidae, and are *Elenchus koebeli* (Pierce) (see Bohart 1941). This species has been reported from Georgia, Kentucky, Louisiana, Mississippi, and Ohio in the United States, and from northern Mexico (Johnson and Morrison 1979; Khalaf 1968, 1969). *Elenchus koebeli* has also been reported from Cocos Island, Costa Rica, 600 km to the northeast of the Galapagos (Hogue and Miller 1981). The Galapagos specimens are indistinguishable from unpublished material in our collections from the semi-arid subtropical forests (hardwood hammocks) of the Florida Keys, which share several plant and insect species with the Galapagos.

The species is known to be an endoparasite of cicadellid leafhoppers in the genus *Liburnia.* Other *Elenchus* are known in species of *Sogata* leafhoppers. These genera are not known from the Galapagos, but other leafhoppers (15 species in 11 genera) are recorded (see Linsley and Usinger 1966; Linsley 1977). One or more of these is the probable host of *E. koebeli.*

Mature female strepsipterans in advanced families such as Elenchidae never leave their cicadellid host, and the males live only a day or two at most (as far as is known). Dispersal to the islands by *Elenchus koebeli* was thus most likely in one or more infected leafhopper hosts. These hosts were most likely winged adults and were carried by air currents from Pacific coastal Mexico or Central America. While most strepsipterans are not, species of *Elenchus* are good at dispersing in their hosts, because there are endemic species on oceanic islands such as Hawaii, Mauritius, and Fiji.

Our field work was supported by grants from the Natural Sciences and Engineering Research Council of Canada; under permit from the Galapagos National Park Service, Direction Forestal, Ministry of Agriculture; and with the support of the Charles Darwin Research Station. Sandra Abedrabbo made her collections available to us for study.

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[1] Contribution no. 426 of the Charles Darwin Research Foundation.

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SCIENTIFIC NOTE

ASAPHIDION FLAVIPES LINNAEUS IN NEW HAMPSHIRE (COLEOPTERA: CARABIDAE)

The European ground beetle *Asaphidion flavipes* Linnaeus was first discovered in North America at Flushing, Long Island, New York (Cooper 1930). It was rediscovered in 1976 at Southampton, also on Long Island (Davidson and Langworthy 1980). Krinsky (1981) subsequently discovered it at North Haven, Connecticut, the first record outside of Long Island.

I have recently found a specimen in the collection of the Entomology Department of the University of New Hampshire, labelled "USA: N.H., Straf. Co., 1 mi. SW Durham, iv-27–v-11, 1987, D. S. Chandler." This indicates a rapid extension northeastward along the Atlantic Coast, about 250 kilometers beyond the Connecticut locality, and over 300 kilometers beyond the original point of introduction, if the New Hampshire specimen does not represent an independent introduction. According to Dr. Chandler (*in litt.*), the habitat "is a manmade swamp that may have originally been a boggy area. It is forested around the edges, and is sandy in areas, and mucky in others. There is good leaf litter around the edges most of the time." This accords well with the more detailed observations on the habitat of the Connecticut specimens (Krinsky 1981).

I thank Robert L. Davidson, Section of Insects & Spiders, Carnegie Museum of Natural History, for calling the paper by Krinsky to my attention and for information on his own collections of the species, and Dr. Donald S. Chandler, Entomology Department, University of New Hampshire, for the loan of the New Hampshire specimen, and for sharing his notes on the collecting site.

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EXCHANGE: Specimens from many families available. I'm interested in Worldwide Cerambycidae and North American Cleridae, Buprestidae and Tenebrionidae, identified or not. Will purchase also. Dan Heffern, 10531 Goldfield Lane, Houston, TX 77064, U.S.A.

Wanted: Due to increasing disability I am no longer able to collect to any great extent. Any surplus Coleoptera you have would be most appreciated. Dr. Trevor G. Forsythe, 5 Knob Hill, Stretton on Dunsmore, Warwickshire, England, CV23 9NN.

WANTED: Sponsorship for trip to S.E. Asia, May–June 1989, visiting Philippines (Palawan), Thailand, Malaysia, Sumatra, and perhaps Sulawesi. Any insects collected using standard collecting or trapping techniques, i.e., Malaise, flight intercept, light, bait and pitfall traps. R. de Keyzer, 3 Cornell St., Blacktown 2148, N.S.W., Australia.

EXCHANGE: North- and Central-American Cerambycidae wanted in exchange for westpaläarctic species (also very rare ones). Dr. Peter Schurmann, A-9020 Klagenfurt, Beethovenstr. 46/II, Austria.

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AVAILABLE FOR STUDY: As a result of extensive sampling of leaf litter faunas throughout Texas for Curculionidae, Leiodidae, Carabidae, a large number of other leaf litter inhabiting Coleoptera (particularly Staphyliniformia) are available mounted or in alcohol for study. Persons interested in loans of these specimens for study should contact H. R. Burke, Department of Entomology, Texas A&M University, College Station, TX 77840, U.S.A.

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