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KEYS AND NOTES ON THE BUPRESTIDAE (COLEOPTERA) OF MICHIGAN¹

Stanley G. Wellso,² Gary V. Manley,³ and John A. Jackman⁴

ABSTRACT

The distribution and dates of adult activity for Michigan buprestids are discussed. Keys to the genera and species, as well as host information are presented for 116 species and one subspecies. Information on collecting techniques, illustrations of genitalia of 14 species, and scanning electron micrographs of certain structures useful in species identification are presented and discussed. In addition, *Pachyschelus confusus*, a new species, is described from bush clover.

INTRODUCTION

Recent North American regional papers on buprestids are those by Knull (1925) for Pennsylvania, Franklin and Lund (1956) for Georgia, and Barr (1971) for the Pacific Northwest. In this paper, we present information on general buprestid collecting techniques, keys, a new species description, distribution, collecting dates and hosts.

The data have been transcribed from specimens in the authors' collections (SGWC, GVMC, JAJC) and those of the following individuals and institutions: Michigan State University (MSUC), Purdue University (PURC), University of Michigan (UMMZ), University of Wisconsin (UWEM), Josef N. Knull (JNKC), Dr. Gayle Nelson (GHNC), and Daniel Young (DYCC). In addition, information previously presented on Michigan species of buprestids by Hubbard and Schwarz (1878) who reported 38 species from the Lower Peninsula and 30 species from the Upper Peninsula, Townsend (1898) who reported three species, and Andrews (1921) who reported 32 species from the Upper Peninsula, has been noted; however, because of synonymy, not all of these records refer to valid species.

COLLECTION TECHNIQUES

Buprestid adults in collections generally do not reflect the abundance of these beetles in our fauna. Because the adult life span approximates a month in duration the host must be known to assure efficient collecting. The following suggestions are presented to enable collectors to improve their collections of adult buprestids.

(1) The most important method is to cage larval host wood so that more information is accumulated about the site of adult oviposition and the host range of the species. Often adults deemed 'unusual' or 'rare' can be reared in this manner. For example, it is difficult to capture adult *Agrilus champlaini* Frost on its host hop hornbeam, *Ostrya virginiana*; however, this species can be readily obtained by collecting its galls from hop-hornbeam and rearing the adults in the laboratory.

(2) More specimens, especially species of *Agrilus*, *Brachys*, *Anthaxia* and *Chrysobothris*, can be swept from the edge of dense deciduous woods than from the interior.

(3) One should concentrate collecting at temperatures above 20°C. Also more specimens are usually taken on clear rather than cloudy days and on still rather than windy days.

(4) Collecting in full sunlight seems to be important; thus, from 10:00 a.m. to noon collect at the southeastern edge of a wood lot, from noon to 3:00 p.m. collect at the

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southern edge, from 4:00 p.m. to 6:00 p.m. on the west edge, and from 6:00 p.m. to 8:00 p.m. on the northern edge in June. A net with a handle of 25 feet in length is useful, since a larger area of leaves exposed to full sunlight may be swept (Fig. 1).

(5) Other sites that warrant observation are trees and shrubs that have been injured or killed, preferably within a few months prior to adult activity. These trees and shrubs are



Fig. 1. A net with a 25-foot aluminum handle enables a collector to sweep a much larger vertical area.

Michigan buprestid species from the three zones are: 45 species from the Upper (U) Zone; 71 species from the Northern Lower (NL) Zone; and 100 species from the Southern Lower (SL) Zone. The following number of species have been collected only in the zone listed: 5 (U), 0 (NL), and 41 (SL).

The seasonal occurrence of adult buprestid activity within each of the zones is presented in Fig. 3. The SL zone with its more diverse flora and more intense collecting shows a greater number of species than the other two zones. Figure 3 does not indicate those species that overwinter either as free-living adults or within their pupal cells; these may be found earlier or later in the year. For example, adult *Taphrocerus gracilis* Say were collected from the bulrush, *Scirpus cyperinus*, as late as November 17, 1973, at Okemos, Michigan, when the temperature reached 20.6°C. All *Taphrocerus* species in Michigan overwinter as free-living adults. The following genera are also known to have some species that overwinter as adults: *Acmaeodera*, *Buprestis*, *Dicerca*, *Ptosima*, *Pachyschelus*.

Keys to the genera and species of Michigan adult buprestids follow. The male genitalia are illustrated for Michigan species of *Chalcophora*, *Anthaxia*, *Pachyschelus* and for *Agrilus pseudofallax*. The complete recorded data are listed only for those species that have two or fewer collection records. Host data are for larval and/or adult collection sites. *Chalcophora lacustris* LeConte is synonymized with *C. virginensis* (Drury), and *Pachyschelus confusus*, new species, is described.

KEY TO GENERA OF MICHIGAN BUPRESTIDAE

1. Scutellum absent, elytra fused along median suture *Acmaeodera* Eschscholtz (p. 12)
- 1'. Scutellum present, elytra separate 2
- 2(1'). Mesal width of metacoxal plates of uniform width or less than lateral width . . 3
- 2'. Mesal width of metacoxal plates greater than lateral width 8
- 3(2). Pronotum truncate at base *Ptosima* Solier (p. 13)
- 3'. Pronotum sinuate at base 4
- 4(3'). Head and prosternum without antennal groove 5
- 4'. Head and prosternum with antennal groove 6
- 5(4). Basal metatarsal segment as long as the next three segments together *Agrilus* Curtis (p. 13)
- 5'. Basal metatarsal segment slightly longer than the next segment *Eupristocerus* Deyrolle (p. 13)
- 6(4'). Scutellum small, 1/6 or less than width of beetle 1
- 6'. Scutellum large, 1/3 width of beetle *Pachyschelus* Solier (p. 17)
- 7(6). Body elongate; prosternum without a pit between procoxae *Taphrocerus* Solier (p. 20)
- 7'. Body ovate; prosternum with a deep pit between procoxae *Brachys* Solier (p. 20)
- 8(2'). Head with deep median longitudinal groove; specimens usually longer than 18 mm 9
- 8'. Head without deep median longitudinal groove; specimens usually shorter than 18 mm 10
- 9(8). Pronotum grooved medially; apical third of lateral margin of elytra strongly serrate; Host: Hardwoods *Chalcophorella* Kerremans (p. 6)
- 9'. Pronotum elevated medially; apical third of lateral margin of elytra entire or finely serrate; Host: Conifers *Chalcophora* Solier (p. 6)
- 10(8'). Posternal process acutely angulate laterally posterior to procoxae 11
- 10'. Posternal process obtuse laterally posterior to procoxae 12
- 11(10). Lateral lobes of third metatarsal segment about equal in length to the second metatarsal segment *Chrysobothris* Eschscholtz (p. 11)
- 11'. Lateral lobes of third metatarsal segment at least twice length of second metatarsal segment *Actenodes* Dejean (p. 12)
- 12(10'). Mentum somewhat translucent *Melanophila* Eschscholtz (p. 9)

- 6(2'). Median groove of pronotum well developed, punctures of upper surface generally coarse laterally and more rugose 7
- 6'. Median groove of pronotum faintly indicated; punctures of upper surface moderate laterally and less rugose 8
- 7(6). Mesotibia of male simple or with a slight apical dilation; Host: Aspen, *Populus* sp. *callosa* Casey
- 7'. Mesotibia of male with well developed lateral tooth; Host: Aspen *tenebrica* (Kirby)

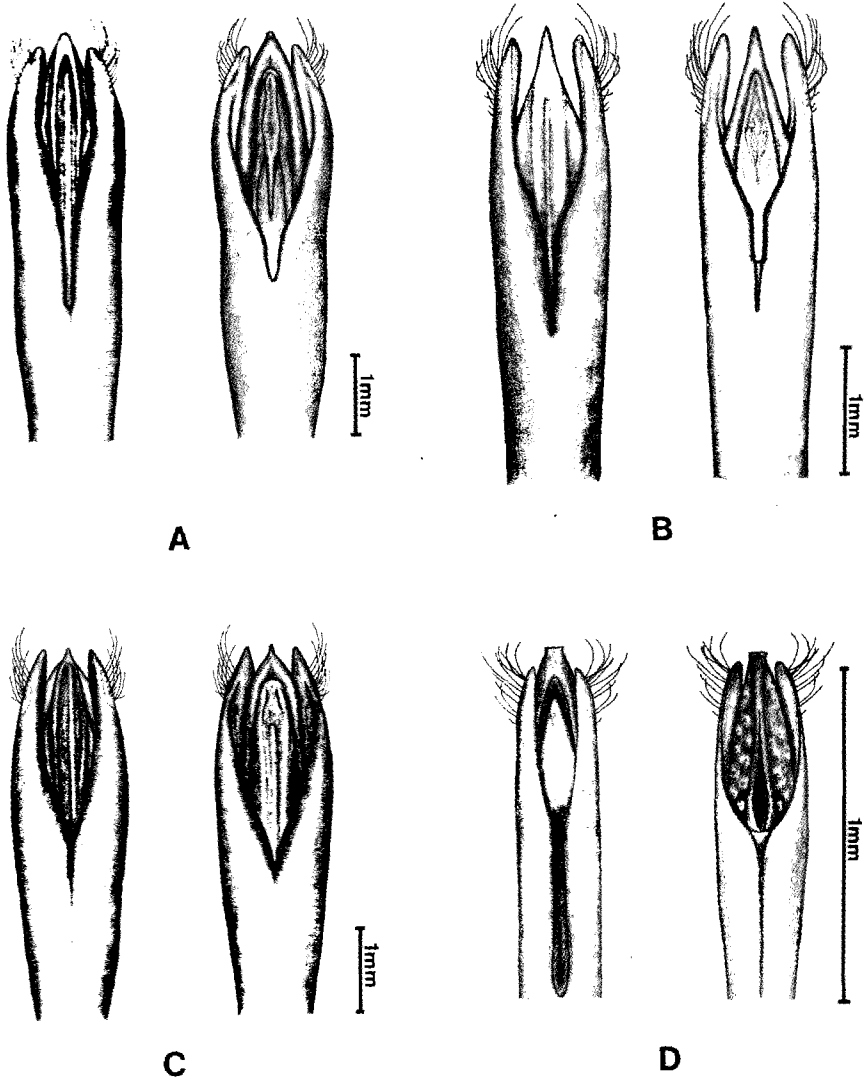


Fig. 4. Male genitalia: dorsal view (left) and ventral view (right). (A) *Chalcopyora virginiensis*, (B) *C. liberta*, (C) *C. fortis*, and (D) *Agrilus pseudofallax*.

- 8(6'). Pronotum widest at middle; elytral striae finely but usually distinctly indicated; lateral lobes of male genitalia rather abruptly tapering to apex; Host: Hardwoods *divaricata* (Say)
- 8'. Pronotum widest at base and feebly rounded to apex (sometimes subparallel towards base); elytral striae but faintly indicated; lateral lobes of male genitalia tapering gradually to apex; Host: Alder, *Alnus* sp. *caudata* LeConte
- 9(1'). Elytral tips distinctly prolonged; Host: Witchhazel, *Hamamelis virginiana* *pugionata* (Germar)
- 9'. Elytral tips not or faintly prolonged 10
- 10(9'). Raised smooth areas of pronotum and elytra distinctly indicated; Host: Oak, *Quercus* sp. *asperata* (LaPorte and Gory)
- 10'. Raised smooth areas of pronotum and elytra feebly indicated. 11
- 11(10'). Hind coxal plate notched with tooth on outer side of notch; pronotal margins narrowed from base to apex; Host: Hardwoods *obscura* (Fabricius)
- 11'. Hind coxal plate indistinctly notched without tooth; pronotal margins subparallel to beyond middle, then converging to apex; Host: Hickory, *Carya* sp. *lurida* (Fabricius)

Genus **POECILONOTA** Eschscholtz

KEY TO THE SPECIES OF *POECILONOTA*

- 1. Apex of elytra usually reddish and elongate *cyanipes* (Say)
This species has been swept from aspen, and reared from the gall of *Agrilus criddlei* on willow. It has been associated with the galls of the longhorn beetles, *Saperda calcarata* Say (Hofer, 1921) and *S. concolor* LeConte (Knull, 1920) in *Populus tremuloides* and *P. deltoides*, respectively.
- 1'. Apex of elytra broadly truncate and not reddish; recorded from Keweenaw Co. *ferrea* (Melsheimer)

Genus **CINYRA** LaPorte and Gory

A single Michigan species, *gracilipes* (Melsheimer) has been collected on: oak; hawthorn, *Crataegus* sp.; and on the flowers of goldenrod, *Solidago* sp.

Genus **BUPRESTIS** Linnaeus

KEY TO THE SPECIES OF *BUPRESTIS*

- 1. Elytra with yellow or orange markings 2
- 1'. Elytra without yellow or orange markings 5
- 2(1). Elytral color green 3
- 2'. Elytral color brown, never greenish 4
- 3(2). Elytral apices strongly bidentate *fasciata* Fabricius
- 3'. Elytral apices pointed; Host: Cottonwood, *Populus deltoides* *confluenta* Say
- 4(2'). Pronotum evenly convex, unicolorous; Host: Conifers *maculipennis* Gory
- 4'. Pronotum with five longitudinally raised areas, bicolored; Host: Conifers *consularis* Gory
- 5(1'). Elytra with raised costae 6
- 5'. Elytra without raised costae; Host: Pine *salisburyensis* (Herbst)
- 6(5). Elytra bronze or black; lateral abdominal sternites maculated with orange or yellow spots; Host: Conifers *maculativentris* Say
- 6'. Elytra greenish or bluish; lateral abdominal sternites not maculated with orange or yellow spots 7
- 7(6'). Apical half of elytra with dense punctures between costae; elytra usually brilliant green to blue with sutural and lateral margins cupreous; anterior angles of pronotum not visible from above 8
- 7'. Apical half of elytra with transverse ridges connecting costae; elytra copper-brown, often with greenish or bluish punctures; anterior angles of pronotum visible from above; Host: Pine *sulcicollis* (LeConte)
Thirty-eight females but no males were collected on bleached driftwood logs on the shore of Lake Superior adjacent to Whitefish Bay in July, 1971.

- 8(7). Elytral costae strongly convex and with summits nearly impunctate; Western N. America; Host: Conifers *aurulenta* Linnaeus
Often emerge indoors, larval life cycle reported as long as 51 years; this species imported in wood from the west.
- 8'. Elytral costae not strongly convex and with summits rather thickly punctate; Host: Conifers *striata* Fabricius

Genus *MELANOPHILA* EschscholtzKEY TO THE SPECIES OF *MELANOPHILA*

1. Elytra without yellow spots and with acute apices; Host: Conifers *acuminata* (DeGeer)
- 1'. Elytra with or without yellow spots and with broadly rounded and usually serrate apices 2
- 2(1'). Length less than 7 mm; without yellow elytral spots; Host: Pine *aeneola* Melsheimer
- 2'. Length greater than 7 mm; usually with yellow elytral spots 3
- 3(2'). Disc of pronotum rough and with rows of large punctures; Host: Conifers *fulvoguttata* (Harris)
- 3'. Disc of pronotum striolate; Host: Conifers *drummondi nicolayi* Obenberger

Genus *ANTHAXIA* Eschscholtz

At least two color forms are found in each of the following four Michigan species of *Anthaxia*: *cyanella* Gory, *fisheri* Obenberger, *quercata* (Fabricius), and *viridifrons* Gory. Since detailed biological studies have not been undertaken, it is unknown whether any of these complexes are represented by more than one species. For example, the thorax and elytra of male *cyanella* individuals range from a bronze-green to a green-blue and all of the females are entirely blue; these color forms occur sympatrically. Thus, some males of *cyanella* and *quercicola* can easily be confused and should be separated by their genitalic differences. Both sexes of *fisheri* are represented by a larger dark purple form and a smaller bronze-green form; they often are collected together from American plum, *Prunus americana*, and have similar genitalia. *Anthaxia quercata* has two size forms with large males being greener and small males more blue-green. The forms are from widely separated localities but have similar genitalia and both occur on oak. Both sexes of *viridifrons* are represented by having either bronze or blue elytra forms; they have emerged from American elm, *Ulmus americana*, and males have similar genitalia.

KEY TO THE SPECIES OF *ANTHAXIA*

1. Tarsal claws with tooth at base 2
- 1'. Tarsal claws without tooth at base 9
- 2(1). Elytra purple-black, tapered strongly at apex; Host: American plum (Male genitalia, Fig. 5A) *fisheri* Obenberger
- 2'. Elytra green, blue or bronze, tapered gradually at apex 3
- 3(2'). Prothorax uniformly green for males and blue for females; female with frons not entirely blue; Host: Oak (Male genitalia, Fig. 5B) *quercicola* Wellso
- 3'. Prothorax bronze or more than one color 4
- 4(3'). Male: frons green 5
- 4'. Female: frons not green 7
- 5(4). Ventral metathoracic sclerite and abdominal sclerites bronze; Host: American plum (Male genitalia, Fig. 5A) *fisheri* Obenberger
- 5'. Ventral metathoracic sclerite green, abdominal sclerites not green 6
- 6(5'). Apical 1/3 of elytra unicolorous; Host: on Hickory (Male genitalia, Fig. 5C) *cyanella* Gory
- 6'. Apical 1/3 of elytra bronze and blue-green (Male genitalia, Fig. 5D) *quercata* (Fabricius)
- 7(4') Elytra blue; front of head blue *cyanella* Gory
- 7'. Elytra not blue 8
- 8(7'). Pronotal disc bronze; Host: American plum *fisheri* Obenberger

- 8'. Pronotal disc bronze with 2 green areas on either side of the midline and along basal margin *quercata* (Fabricius)
- 9(1'). Pronotum with 4 depressions; 2 on either side of midline located centrally on the disc, and 2 near the humeral angles causing the adjacent margin to appear flat; color dorsally bronze (Male genitalia, Fig. 5E); Host: Conifers; emerged from Black spruce, *Picea mariana* *expansa* LeConte
- 9'. Pronotum not as described above 10
- 10(9'). Lateral pronotal margins each for 1/4 width of thorax differing from the disc color; elytra dark blackish-purple; Host: Willow (Male genitalia, Fig. 5F) *viridicornis* (Say)
- 10'. Lateral pronotal margins each more broadly pigmented anteriorly than posteriorly and differing in color from disc; elytra uniformly bronze, blue or dark purple; Host: Elm, *Ulmus* sp. and Hickory (Male genitalia, Fig. 5G) *viridifrons* Gory

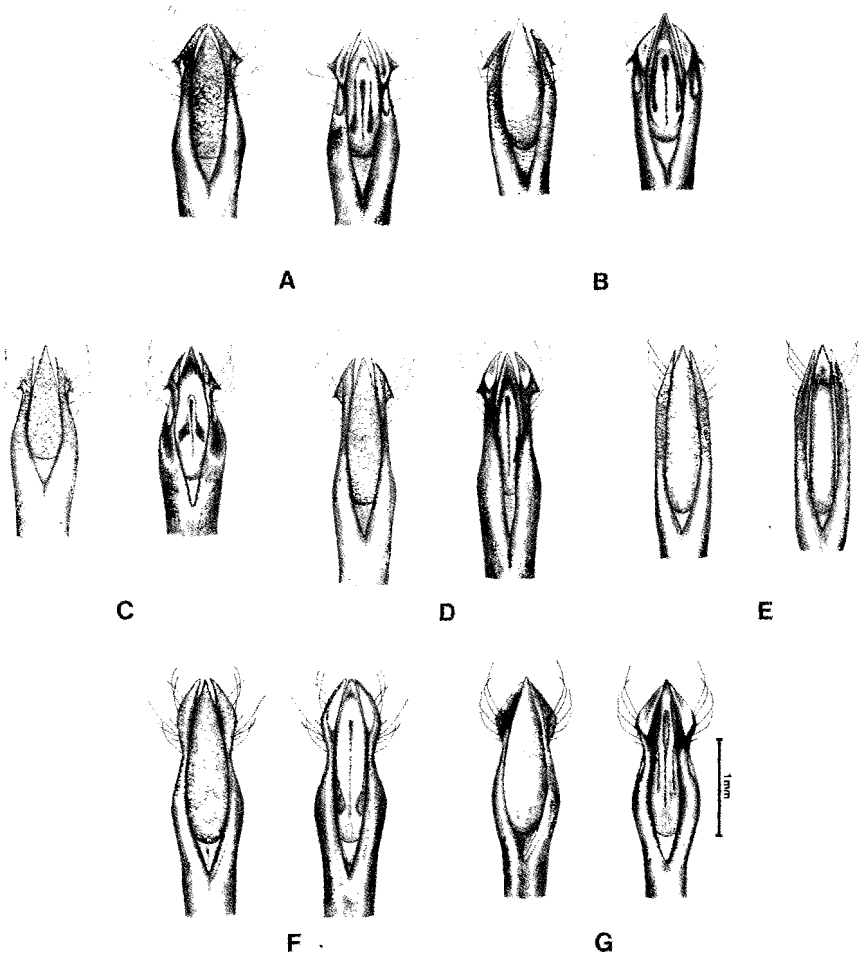


Fig. 5. *Anthaxia* male genitalia: dorsal view (left) and ventral view (right). (A) *fisheri*, (B) *quercicola*, (C) *cyanella*, (D) *quercata*, (E) *expansa*, (F) *viridicornis*, and (G) *viridifrons*.

Genus *AGRILAXIA* Kerremans

Three specimens of a single Michigan species, *flavimana* (Gory), were collected in a mixed hardwoods at Romulus, Wayne County, on 16-VII-1974 by Richard S. Taylor.

Tribe CHRYSOBOTHRINI

Genus *CHRYSOBOTHRIS* EschscholtzKEY TO THE SPECIES OF *CHRYSOBOTHRIS*

1. Lateral margin of last abdominal sternite serrate. 2
- 1' Lateral margin of last abdominal sternite not serrate; rarely interrupted. 15
- 2(1). Disc of pronotum uneven, longitudinally sulcate at middle, and frequently with elevated callosities 3
- 2'. Disc of pronotum even, without a distinct median depression or elevated callosities 17
- 3(2). Clypeus transversely truncate or slightly sinuate in front; Host: Pine *floricola* Gory
- 3'. Clypeus emarginate in front. 4
- 4(3'). Anterior tibia of male with several small spines on its inner margin; 8th abdominal tergite of female medially carinate 5
- 4'. Anterior tibia of male with a single apical spine and dilated near the apex on the inner margin; 8th abdominal tergite of female not medially carinate. 9
- 5(4). Clypeus acutely notched at middle but not semicircularly rounded on each side 6
- 5'. Clypeus semicircularly rounded on each side of notched middle (Fig. 6) 7
- 6(5). Male: front of head bright green; female: underside greenish medially; Host: Hickory. *adelpa* Gemminger & Harold
- 6'. Male: front of head, greenish-bronze; female: underside purplish-bronze; Host: American plum *sloicola* Manley & Wellso
- 7(5'). Antenna gradually narrowed to apex, the last segment not distinctly quadrate and narrower than the tenth segment 8
- 7'. Antenna not narrowed to apex, the last segment quadrate and as wide as the tenth segment; Host: Hardwoods (Fig. 6). *rugosiceps* Melsheimer
- 8(7). Male antennal segments pale yellow on outer margin; elytral disc and apex unicolorous; posterior pair of foveae separated by a longitudinal costa; Host: Hardwoods. *viridiceps* Melsheimer
- 8'. Male antennal segments bronzy-green and usually reddish-cupreous toward apex; elytral disc and apex bicolored with the apex reddish; posterior pair of foveae usually confluent, the bisecting costa interrupted; Host: Hardwoods. *femorata* (Olivier)
- 9(4'). Body above green to violaceous blue or purple; Host: Pine *harrisi* (Hentz)
- 9'. Body above bronze, black or brownish-cupreous 10
- 10(9'). Antennal segments 4 to 11 yellow on outer margin; Host: Pine *dentipes* (Germar)
- 10'. Antennal segments 4 to 11 not yellow on outer margin 11
- 11(10'). Prosternum with an anterior median lobe. 12
- 11'. Prosternum without an anterior median lobe 13
- 12(11). Clypeus shallowly emarginate in front; length: smaller than 10 mm; Host: Conifers *pusilla* Castelnau & Gory
- 12'. Clypeus deeply emarginate in front; length: larger than 10 mm; Host: Conifers *blanchardi* Horn
- 13(11'). Larger species: 14-17 mm; Host: Pine *orono* Front
- 13'. Smaller species: 8-13 mm 14
- 14(13'). Male: posterior tibia arcuate; female: abdomen broadly arcuately emarginate ventrally at apex; Host: Conifers. *scabripennis* Castelnau & Gory
- 14'. Male: posterior tibia of male straight; female: abdomen triangularly emarginate ventrally at apex; Host: Conifers. *trinervia* (Kirby)
- 15(1'). Elytra without longitudinal costae; Host: Oak *concinula* LeConte



Fig. 6. Head of *Chrysobothris rugosiceps*. Arrow pointing to the semicircularly emarginate clypeus.

One record: Livingston County, 2 mi. N. of Whitmore Lake, 4-VII-1956, G. H. Nelson.

- 15'. Elytra with costae 16
 16(15'). Body above dark bronzy-brown; Host: Hardwoods and Conifers; emerged from Black spruce *sexsignata* (Say)
 16'. Body above violaceous, blue or cupreous; Host: Oak *azurea* LeConte
 17(2'). Elytra with distinct foveae; Host: Conifers *pusilla* Castelnau & Gory
 17'. Elytra without distinct foveae; Host: Pine *harrisi* (Hentz)

Genus ACTENODES Dejean

KEY TO THE SPECIES OF ACTENODES

1. Fourth antennal segment strongly triangular, at widest part nearly twice as wide as third, and the following segments transverse; Host: Maple *acornis* (Say)
 1'. Fourth antennal segment slightly wider than third, the following segments not transverse *sini* Fisher
 Two records: Berrien County, 4-VII (UMMZ); Manistee County, 5-VII-1952, R. Dreisbach (MSUC).

Subfamily ACMAEODERINAE

Tribe ACMAEODERINI

Genus ACMAEODERA Eschscholtz

KEY TO THE SPECIES OF ACMAEODERA

1. Elytra dark with isolated spots; last ventral sternite without subapical plate, procoxae with branched setae (Fig. 7); Host: Hardwoods . . . *tubulus* (Fabricius)



Fig. 7. Branched setae on fore coxa of *Acmaeodera tubulus*.

Frequently found feeding on the petals of wild geranium, *Geranium maculatum*, and occasionally found ovipositing on red oak, *Quercus borealis*.

- 1'. Elytra with elongate yellow markings; last ventral sternite with a subapical plate; pronotum usually with a lateral yellow spot; procoxae without branched setae. *pulchella* (Herbst)

Genus PTOSIMA Solier

A dark blue and yellow species, *gibbicollis* (Say), inhabits redbud, *Cercis canadensis*, in southern Michigan.

Subfamily AGRILINAE

Tribe AGRILINI

Genus EUPRISTOCERUS Deyrolle

A single robust species, *cogitans* (Weber), with a copper colored thorax and black elytra with faint white pubescent markings, is often collected on speckled alder, *Alnus rugosa*.

Genus AGRILUS Curtis

KEY TO THE SPECIES OF AGRILUS

- 1. Elytral apices prolonged, terminating in a large spine. *ferrisi* Dury
One record: Three pupae collected from hackberry, *Celtis occidentalis*, from Ingham County, Okemos, 15-VI-1972
- 1'. Elytral apices not prolonged 2

2(1').	Antennae serrate beginning with the fourth segment	3
2'.	Antennae serrate beginning with the fifth segment	37
3(2).	Tarsal claws bifid with the inner tips nearly touching	4
3'.	Tarsal claws bifid with the inner tips widely separated	18
4(3).	Pygidium with a projecting carina	5
4'.	Pygidium without a projecting carina	6
5(4).	Body above uniformly black; Host: Hop hornbeam. <i>champlaini</i> Frost Most easily collected by rearing adults from hop hornbeam galls.	
5'.	Head and thorax cupreous (occasionally with a bluish tinge), elytra black; Host: Stem galls on blackberry, raspberry, and dewberry, <i>Rubus</i> sp. <i>ruficollis</i> (Fabricius)	
6(4').	Abdominal segments with pubescent spots laterally; Host: Honey locust, <i>Gleditsia triacanthos</i> <i>difficilis</i> Gory One record: Port Huron (Hubbard and Schwarz, 1878). No specimens seen.	
6'.	Abdominal segments without pubescent spots laterally	7
7(6').	Male: Metatibiae without a distinct apical spine on the inner margin	8
7'.	Male: Metatibiae with a distinct apical spine on the inner margin	9
8(7).	Metatarsi shorter than tibiae; segment one as long as the combined length of the next three segments; Host: Hardwoods <i>arcuatus</i> (Say)	
8'.	Metatarsi as long or longer than the tibiae; segment one as long as next four segments; Host: Boxelder, <i>Acer negundo</i> , and hop hornbeam. <i>masculus</i> Horn	
9(7').	Antennal segments with long white setae beneath; Host: Oak. <i>crnicornis</i> Horn	
9'.	Antennal segments without long pubescence beneath	10
10(9').	Male: last ventral abdominal segment fimbriate at apex; Host: Oak <i>defectus</i> LeConte	
10'.	Male: last ventral abdominal segment not fimbriate at apex	11
11.(10').	Male: prosternum conspicuously pubescent.	12
11'.	Male: prosternum not conspicuously pubescent	15
12(11).	Prosternum deeply emarginate; Host: Black walnut, <i>Juglans nigra</i> (reared specimens) <i>cliftoni</i> Knull	
12'.	Prosternum truncate or slightly emarginate.	13
13(12').	Prehumeral carina of pronotum very indistinct; male genitalia with parameres parallel; Host: Oak <i>geminatus</i> (Say)	
13'.	Prehumeral carina of pronotum very distinct; male genitalia with parameres expanded.	14
14(13').	Frons with dense pubescence nearly concealing the surface behind the epistoma; pronotum bicolored; Host: Hickory <i>otiosus</i> Say	
14'.	Frons with pubescence but not concealing the surface of the epistoma; pronotum unicolored dorsally; Host: Hazelnut, <i>Corylus americana</i> <i>atricornis</i> Fisher	
15(11').	Male: second abdominal segment transversely concave; Host: Black walnut <i>transimpressus</i> Fall	
15'.	Male: second abdominal segment not transversely concave	16
16(15').	Male genitalia with protruding fleshy lobes at apex of parameres; frons usually bluish; Host: Hop hornbeam <i>osburni</i> Knull	
16'.	Male genitalia without protruding fleshy lobes at apex of parameres; frons bluish or greenish	17
17(16').	Male genitalia expanded near middle and parameres with tips parallel; Host: Butternut, <i>Juglans cinerea</i> <i>juglandis</i> Knull	
17'.	Male genitalia expanded near middle and parameres arced to apex; Host: Oak. <i>frosti</i> Knull	
18(3').	Pygidium with a projecting carina	19
18'.	Pygidium without a projecting carina	30
19(18).	Pronotum with a densely pubescent median longitudinal groove; Host: Haw- thorn; Apple, <i>Malus pumila</i> ; and Serviceberry, <i>Amelanchier</i> sp. <i>vittaticollis</i> (Randall)	
19'.	Pronotum without a densely pubescent median longitudinal groove	20

- 20(19'). Pronotum without, or with only feebly indicated, prehumeral carinae.21
 20'. Pronotum with distinct prehumeral carinae.25
 21(20). Elytra with pubescent spots or pubescent vittae.22
 21'. Elytra without pubescent spots or pubescent vittae.23
 22(21). Elytra black with a distinct whitish or yellowish pubescent vitta on each elytron;
 Host: Oak *bilineatus* (Weber)
 22'. Elytra blue or bluish-black with an indistinct pubescent vitta in the basal
 depressions of each elytron; Host: Hop hornbeam *bilineatus carpini* Knull
 23(21'). Vertical aspect of the abdominal segments densely pubescent (except sometimes
 the second)24
 23'. Vertical aspect of abdominal segments not conspicuously pubescent; Host:
 Willow *criddlei* Frost
 This species forms distinct galls (Fig. 8) that are often split open revealing the
 underlying cambium.
 24(23). Elytra blue or blue-black; vertical surface of second abdominal segment glabrous,
 all others segment with white pubescence; Host: American hazel, Hop hornbeam,
 Oak *acutipennis* Mannerheim



Fig. 8. Willow stem gall of *Agrilus criddlei* showing typical fissures in bark exposing the underlying cambium.

- 24'. Elytra olivaceous bronze to black; vertical surfaces of all abdominal segments with white or gold pubescence; Host: Oak *quadriimpressus* Ziegler
- 25(20'). Vertical surface of abdominal segments (except sometimes the second) conspicuously pubescent 26
- 25'. Vertical surface of all abdominal segments uniformly, but not conspicuously pubescent 27
- 26(25). Frons densely pubescent, the pubescence nearly obscuring the surface; elytral apex broadly rounded; Host: Lombardy poplar, *Populus nigra* L. var. *italica* *granulatus* (Say)
- 26'. Frons not densely pubescent, the surface distinctly visible; elytral apex acute or narrowly rounded; Host: Willow *quadriguttatus* Gory
- 27(25'). Lateral margins of pronotum with a reddish tinge; elytra greenish-bronze to reddish-cupreous with a faint pubescent spot at apical third, often running indistinctly along the sutural margin to apex; Host: Alder *pensus* Horn
The color of 45 Michigan specimens reared from alder was more variable than Fisher (1928) noted; also, Michigan specimens as reported previously by Carlson (1969) typically have an indistinct apical elytral spot.
- 27'. Above olivaceous black or blue-gray to bronze 28
- 28(27'). Vertical surface of abdominal segments obscured by an even distribution of pubescence; Host: Shoots of Quaking aspen, *Populus tremuloides*, or Big tooth aspen, *P. grandidentata* (Nord et al., 1971), *horni* Kerremans
- 28'. Vertical surface of abdominal segments with some pubescence but not obscuring the surface 29
- 29(28'). Elytra without pubescent spots; male genitalia ventrally with the bevel of the inner margin of each paramere wide; female with projecting pygidial spine about equal in length and width, elliptical in cross section at apex; Host: Birch, *Betula* sp. *anxius* Gory
- 29'. Elytra often with a pair of indistinct spots at basal third; male genitalia ventrally with the bevel of the inner margin of each paramere narrow; female with projecting pygidial spine longer than wide, rounded in cross section at apex; Host: Aspen *liragus* Barter & Brown
- 30(18'). Elytra with pubescent spots or lines 31
- 30'. Elytra without pubescent spots or lines 32
- 31(30). Prosternal lobe deeply emarginate in front; Host: Hardwoods *obsoletoguttatus* Gory
- 31'. Prosternal lobe not deeply emarginate in front; Host: Honey locust and Hackberry *fallax* Say
- 32(30'). Outer antennal segments (7-11) distinctly wider than long 33
- 32'. Outer antennal segments (7-11) not distinctly wider than long 34
- 33(32). Prosternal lobe broadly rounded in front; Host: Stem galls on Raspberry, *Rubus* sp. and Rose, *Rosa* sp. *rubicola* Abeille
- 33'. Prosternal lobe emarginate in front; Host: Willow *politus* (Say)
- 34(32'). Dorsally dark blue to greenish-blue; prosternal lobe deeply emarginate in front; Host: Tartarian honeysuckle, *Lonicera tartarica* *coeruleus* (Rossi)
- 34'. Dorsally not blueish; prosternal lobe shallowly emarginate in front, elytra bronze or purple-reddish 35
- 35(34'). Elytra blackish-bronze to olivaceous; setae on lower fourth of face more dense, obscuring surface; Host: Dogwood, *Cornus* sp. *cephalicus* LeConte
- 35'. Elytra usually reddish at apex or with purple tinge; setae on lower fourth of face not obscuring surface 36
- 36(35'). Body above unicolored; pronotum and elytra the same color; Host: Hawthorn *crataegi* Frost
- 36'. Body above bicolored; pronotum cupreous and elytra purplish or piceous; Host: Serviceberry *amelanchieri* Knull
- 37(2'). Elytra with pubescent spots, vittae, or irregular designs 38
- 37'. Elytra sometimes uniformly pubescent but never patterned 41
- 38(37). Pronotum with prehumeral carinae 39

- 38'. Pronotum without prehumeral carinae; Host: Privet, *Ligustrum* sp. *subcinctus* Gory
- 39(38). Elytra with pubescent spots. 40
- 39'. Elytra with irregular pubescent designs; Host: Hackberry. *lecontei* Saunders
- 40(39). Elytral pubescent spots distinct, medial spots rounded; [Male genitalia refigured from Fisher (1928) (Fig. 4D)]; Host: Honey locust *pseudofallax* Frost
- 40'. Elytral pubescent spots indistinct, medial spots elongate; Host: Honey locust *egeniformis* Champlain & Knull
- 41(37'). Pronotum with prehumeral carinae 42
- 41'. Pronotum without prehumeral carinae; Host: Maple *putillus* Say
- 42(41). Surface above bicolored; Host: False indigo, *Amorpha fruticosa* *pusillus* (Say)
- 42'. Surface above unicolored 43
- 43(42'). Elytra uniformly sparsely clothed with distinct white hairs; prosternum deeply emarginate in front; Host: Hackberry *olentangyi* Champlain & Knull
One record: Lenawee County, Morenci, 13-VI-1974, S. G. Wellso
- 43'. Elytra not uniformly clothed with distinct hairs, although an indistinct pubescent vitta may be present on each elytron; prosternal lobe truncate or slightly emarginate 44
- 44(43'). Each elytron with a very indistinct often interrupted sutural vitta; apex of aedeagus blunt; Host: Hackberry *paracelti* Knull
- 44'. Elytra with distinct pubescence only in humeral depression 45
- 45(44'). Male genitalia with sides of the parameres nearly parallel; Host: Hackberry. *celti* Knull
- 45'. Male genitalia with sides of the parameres very strongly, arcuately expanded; Host: Black locust, *Robinia pseudoacacia* *egenus* Gory

Genus PACHYSCHELUS Solier

KEY TO THE SPECIES OF PACHYSCHELUS

1. Elytra purple with white pubescent markings; male genitalia (Fig. 9A); Host: Wild geranium *purpureus* (Say)
- 1'. Elytra black without white pubescent markings 2
- 2(1'). Male genitalia (Fig. 9B); Host: *Desmodium* sp. *laevigatus* Say
- 2'. Male genitalia (Fig. 9C, D); Host: *Lespedeza* sp. *confusus* n.sp.

Pachyschelus confusus Wellso and Manley, NEW SPECIES

HOLOTYPE MALE: Form and size of *P. laevigatus* (Say); ovate; color uniformly shining black.

Head convex, slightly bronze, with longitudinal depression in front; surface with a few scattered punctures and setae; surface between punctures finely granulose.

Pronotum widest at base, narrowest at apex, sides arcuate from the apex to base, hind angles slightly produced; surface with scattered punctures, each puncture bearing a single recumbent seta; surface between punctures finely granulose; scutellum trapezoid, impunctate, and glabrous.

Elytra almost as broad as pronotum, widest at base, narrowest at apex, sides arcuate from apex to base, tips rounded and entire lateral apical margins serrulate; disk convex, each elytron with a lateral excavation behind umbone; surface with punctures, each puncture bearing a single recumbent white seta (Fig. 10A).

Ventral surface (Fig. 10B) concolorous with dorsal; underside of thorax with scattered punctures, medially with scattered, moderately long white setae; hind tibia with a concave area about midway on outer margin containing a row of stout setae (Fig. 10C); abdomen minutely granulate and bearing scattered short white setae; last abdominal sternite with scattered small tubercles, setae denser and longer than on other abdominal segments, posteriorly obtusely rounded with a small spine at apex. Size: length 2.13 mm; width, 1.27 mm.

ALLOTYPE FEMALE: Differs from the male by having the last abdominal sternite depressed, with two sets of four teeth on either side of the apex (Fig. 10D). Size: length, 2.19 mm; width, 1.48 mm.

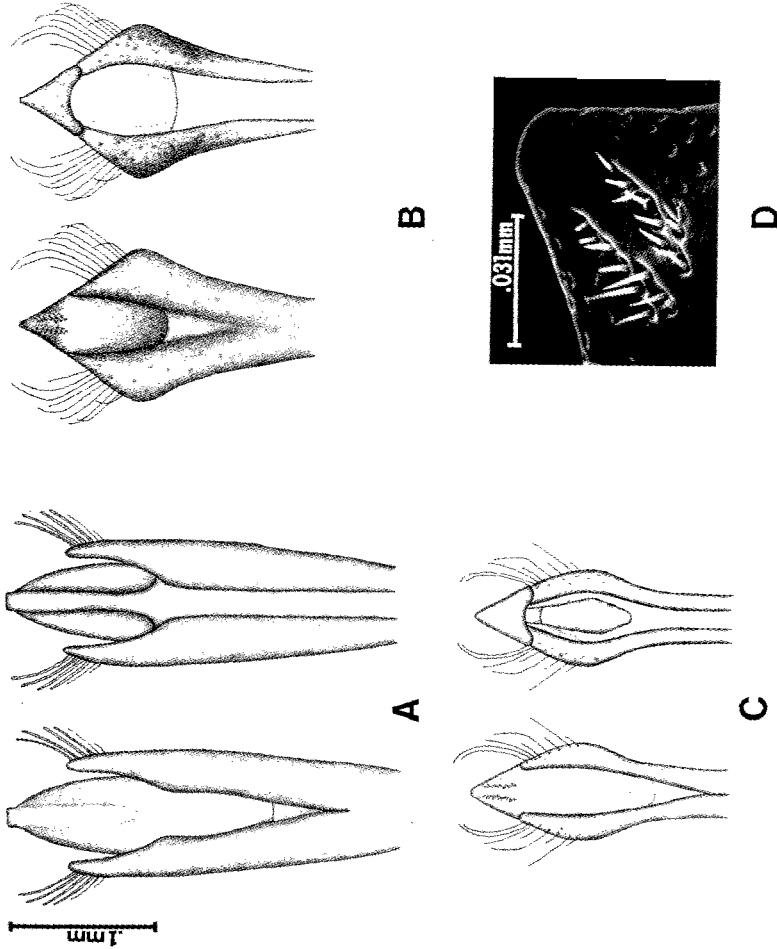


Fig. 9. *Pachyschelus* male genitalia: (A-c) dorsal view (left) and ventral view (right). (A) *purpureus*, (B) *confusus* n.sp., (C) *laevigatus*, and (D) detail of dorsal apex of aedeagus of *confusus* n.sp.

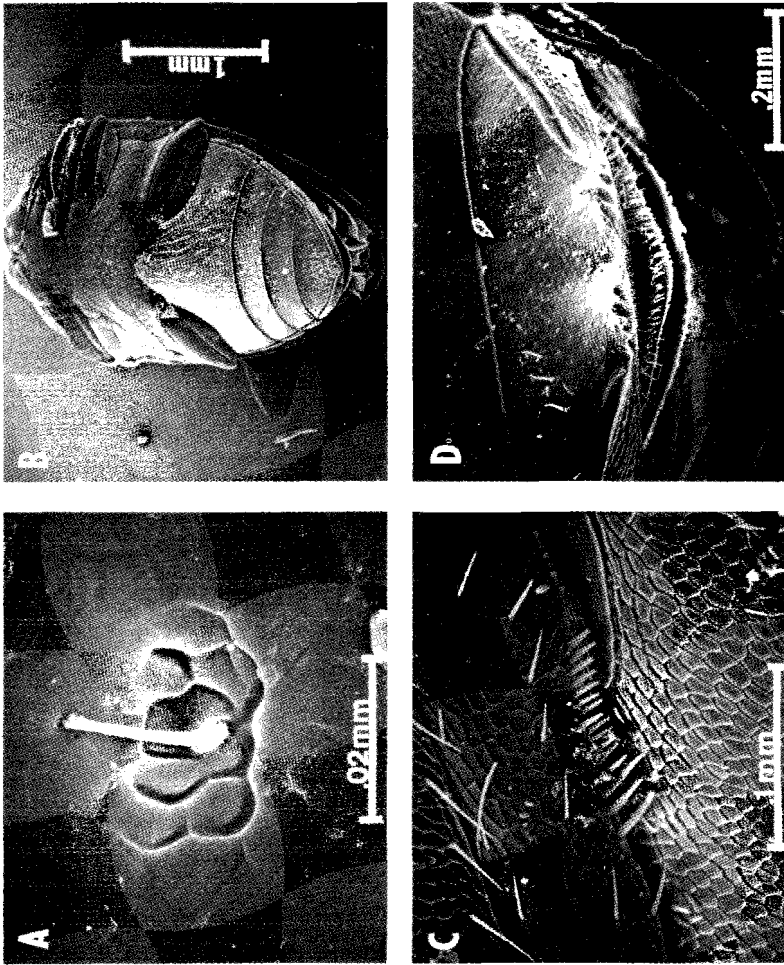


Fig. 10. *Pachyschelus confusus* n.sp.: (A) seta on dorsal elytron surface, (B) ventral view of male, (C) metatibia comb, and (D) note two sets of four spines on last visible abdominal segment of female.

TYPES: Holotype male: Michigan: Shiawassee County, T5N R1E Sec. 21, 21-VIII-1974, G. V. Manley, sweeping bush clover, *Lespedeza capitata* Michx. Allotype female: Same collection data as holotype. Both types deposited in MSUC. Paratypes: 460 males and 380 females from type locality in late August; 13 males and 7 females collected by Daniel Young at the type locality on 4-VI-1975; and 25 males and 16 females from Oakland County, T2N R8E Sec. 21, 8-VI-1974, G. V. Manley. Paratypes deposited in authors' collections, MSUC, UMMZ, UWEM, JNKC, GHNC, DYCC, USNM, MCZC, AMNH, CASC, CHAH [Abbreviations listed in Arnett and Samuelson (1969)].

VARIATION: No variation noted other than the range in size. Males: length, 1.92-2.33 mm; width, 1.14-1.31 mm. Females: length, 2.13-2.51 mm; width, 1.31-1.49 mm.

COMPARISON: This species is very similar to *laevigatus* Say and is undoubtedly placed with it in collections. The two species can be separated by the male genitalia (Fig. 9B, C). In Michigan, *confusus* is associated with *Lespedeza* sp. (specifically *capitata*), and *laevigatus* with *Desmodium* sp. (specifically *canadense*).

Genus BRACHYS Solier

KEY TO THE SPECIES OF BRACHYS

1. Last ventral segment with long hairs along the emargination; usually larger than 5.5 mm; Host Oak *ovatus* (Weber)
Apparently parthenogenic in Michigan, since no males were represented in over 100 specimens examined.
- 1'. Last ventral segment without long hairs along the emargination; usually smaller than 5.5 mm. 2
- 2(1'). Elytra with a purple, blue, or green luster especially in the humeral region; apical elytral setae predominately gold; length, 3-5.75 mm; Host: Hardwoods, usually oak *aerosa* Melsheimer
- 2'. Elytra dark brassy; apical elytral setae light gold to silver; length, 3-3.75 mm; Host: Oak *aeruginosus* Gory

Genus TAPHROCERUS Solier

All of these species have been collected on bulrushes.

KEY TO THE SPECIES OF TAPHROCERUS

1. Elytra with pubescent markings 2
- 1'. Elytra without pubescent markings *schaefferi* Nicolay & Weiss
- 2(1). Smaller species: less than 3 mm in length. *nicolayi* Obenberger
- 2'. Larger species: usually greater than 3 mm in length. *gracilis* Say
We speculate that the forward pointing thoracic sensilla may be used to give the beetle the information to ensure that it does not become so tightly lodged between the bases of two adjacent bulrush blades that its legs could not be extended (Fig. 11).

ADDITIONAL SPECIES AND STUDIES

Certain species, although not available during the preparation of this paper, probably occur in Michigan. These include: *Acmaeodera ornatooides* Barr, *Chrysobothris chryseola* Illiger, *C. verdigripennis* Frost, *Poecilinota thureura* Say, and *Ptosima walshii* LeConte.

Additional studies are warranted on *Anthaxia* sp., as well as on the *Agrilus anxius*, *A. acutipennis*, *A. arcuatus*, *A. politus*, and *Chrysobothris femorata* complexes. Biological studies are necessary to better define the species limits, and separate or combine subspecies and color morphs.

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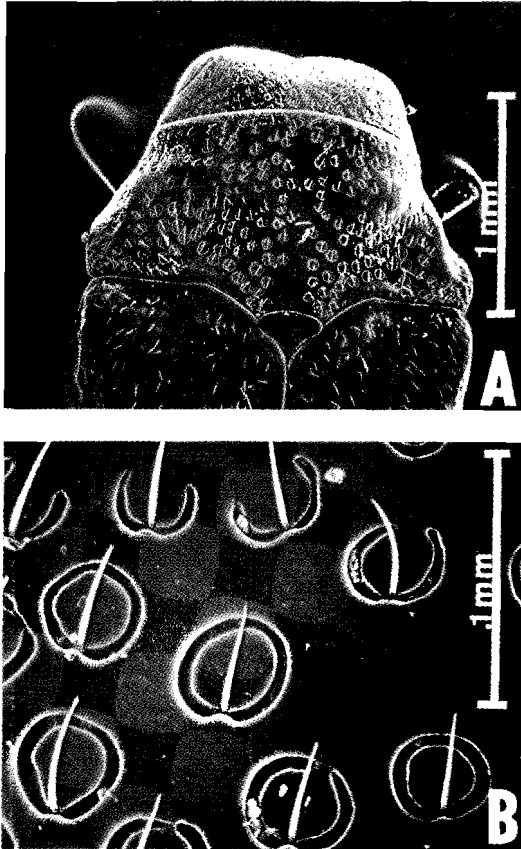


Fig. 11. *Taphrocerus gracilis*: (A) head and pronotum, and (B) pronotal "belt buckle" sensory organs whose setae point anterad.

receiving the loan of holotypes of *Chalcophora lacustris* LeConte and *Agrilus pseudofallax* Frost from Janice C. Scott at the MCZC, and the loan of specimens from Dr. Irving Cantrall at the UMMZ. We express our appreciation to William S. McAfee and Arthur Ackerman for their technical assistance in obtaining the scanning electron micrographs.

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