A REVISION OF THE GENUS XENODUSA WASMANN (COLEOPTERA: STAPHYLINIDAE: ALEOCHARINAE) OF NORTH AMERICA

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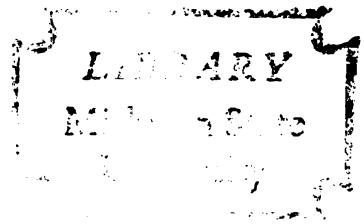
THESIS



ABSTRACT

A REVISION OF THE
GENUS XENODUSA WASMANN
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OF NORTH AMERICA

By

E. Richard Hoebeke

The species of the genus Xenodusa Wasmann (Staphylinidae: Aleocharinae) of North America are revised to include six species. In addition, two subspecies and a variety are synonymized, while another variety is placed in incertae sedis. The genus is divided into two subgenera: Xenodusa sensu stricto and Pseudolomechusa Mann. The male genital tubes, the hypomera of the pronota, and other major diagnostic features are illustrated and the distribution of each species is mapped. Diagnostic keys to the subgenera and species, supplemented with photographs of each species, are included. A discussion of the nomenclatural history of the genus, the biology, and the general morphology is also added.

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E. Richard Hoebeke

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INTRODUCTION

The species of the genus Xenodusa are among a moderate number of myrmecophilous staphylinid genera. This genus is a member of the largest subfamily, Aleocharinae of the Staphylinidae. This poorly studied subfamily contains over 300 genera worldwide and upwards of 5000 species. Most aleocharines are small beetles, the majority less than 3 mm long. All of this accounts for the meager understanding of the subfamily.

The late Reverend Erich Wasmann, an early pioneer in the study of myrmecophilous Coleoptera, spent much of his later years in the study of Xenodusa, and the allied genera, Atemeles and Lomechusa. Wasmann referred to these three genera as the "Lomechusa group", with the species of Xenodusa restricted to the Nearctic region and those of Atemeles and Lomechusa to the Palearctic fauna. A brief synopsis of the history of the classification of Xenodusa will be beneficial to the taxonomic discussion that follows.

NOMENCLATURAL HISTORY

The first known species of Xenodusa were described in the middle 1800's from Pennsylvania as Atemeles cavus (LeConte, 1863) and from Vancouver Island as Atemeles reflexus (Walker, 1866). Gemminger and Harold (1868) also listed these two species in the Palearctic genus Atemeles, as did Crotch (1873) with cavus. Henshaw (1885) placed cavus in the European genus Lomechusa. Casey (1886) described Lomechusa montana from California. Wasmann (1893) described the variety hirsutus of cavus based on comparison of specimens of cavus from Michigan, but he apparently was not aware of montana described by Casey in 1886, when describing hirsutus. Thus, after reexamination of his type of hirsutus with montana, Wasmann (1896) decided that hirsutus was a variety of montana rather than cavus. Wasmann (1894) proposed the genus Xenodusa for North America, but declined to designate a type-species. Fauvel (1895) synonymized reflexa with cava. Wasmann (1896) constructed the first key to the species of Xenodusa and included a new species, sharpi. His key treated the known forms--cava, montana, and sharpi, and included reflexa as a variety of cava, disagreeing with that of Fauvel, and hirsutus a variety of montana. Wasmann (1897) described Xenodusa caseyi from Colorado, and erected another key to now include cava, montana, sharpi, and caseyi. Wasmann (1899) described major as a variety of cava. Fall (1901) described Lomechusa angusta from southern California, while Casey (1911)

described two species--lobata from Iowa and probata from Pennsylvania. Mann (1914), upon examination of sharpi, decided to place it in its own subgenus, Pseudolomechusa.

Subsequent to the erection of Pseudolomechusa as a subgenus, the classification of the group has been approached in a number of ways. Various lists by Fenyes (1918), Leng (1920), and Bernhauer & Scheerpeltz (1926) have each catalogued the species for North America.

This paper recognizes six species for North America. Two subspecies and a variety have been placed in synonymy. Also a variety of Wasmann (1899) is placed in incertae sedis.

BIOLOGY

The adult habits of the species of Xenodusa are known fairly well, and all are myrmecophiles. Wasmann (1906), Wheeler (1910, 1911), and Balduff (1935) concur that Xenodusa is "double-hosted" with ants of the genera Camponotus and Formica. Some specimens on loan to the author had ants accompanying them other than the above genera, namely ants of the genus Myrmica.

The biology of the two very closely related Palearctic genera, Atemeles and Lomechusa, is much more complete than that of Xenodusa of the Nearctic. Hölldobler (1967, 1969) concluded, after extensive physiological and behavioral studies, that the larvae of Atemeles pubicollis Bristol and Lomechusa strumosa Fabricius are treated by Formica spp. as their own brood, that the beetle larvae beg similar to that of Formica larvae, that dorsal-lateral glands on the larvae produce substances that the ants lick, and that the beetle larvae are strong competitors with the Formica larvae for food. Hölldobler also found that Atemeles pubicollis finds its hosts by odor, probably colony odor. After emergence from the pupa, the beetle is attracted to odors of Myrmica spp., with which it hibernates. Following hibernation, the beetle is attracted to Formica spp., in whose nest it reproduces. Wasmann (1888, 1914) added much to our knowledge concerning the biology and host relations of Atemeles emarginatus Gravenhorst and Atemeles

paradoxus Gravenhorst, which included numbers of beetles found in nests of Myrmica spp., hybridization and varieties, reproduction, development, life-spans, parasitic relationship with the ants, and odors of the beetles and Myrmica spp. Discussions on the mating, development, parasitic behavior, and odors of Lomechusa strumosa, and the development of the larvae of Atemeles spp. are also noted by Wasmann. Donisthorpe (1927) recorded distribution, mating behavior, defense of the beetles against the ant hosts, and larval discussions of Atemeles emarginatus and paradoxus and Lomechusa strumosa of Britian.

The knowledge of the life histories of Xenodusa has been difficult to obtain. Larvae of Xenodusa have rarely been collected, and are virtually unknown. Wheeler (1911) described the larvae of Xenodusa cava (LeC.) and contributed notes on the comparison of this larva with that of Lomechusa strumosa. In 1914, Mann described the larva of Xenodusa sharpi.

Ants of the genus Camponotus, the carpenter ants which work in rotting wood, are the secondary hosts of Xenodusa and provide over-wintering sites for the beetles, whereas the primary host, Formica spp., accomodates the reproducing beetles in the summer months (Wheeler, 1911). Wheeler also noted that the larvae of Xenodusa cava mimicked larvae of Formica spp. by begging for food from the adult ants; and that some Xenodusa larvae devoured ant brood.

Nests of Camponotus noveboracensis (Fitch) and Formica obscuripes obscuripes Forel were examined in upper Michigan in November. Many adult beetles were found with C. noveboracensis, however, not a single

beetle was found with Formica. Also, nests of other Formica spp. were examined in Michigan from May through July, but no beetles were found.

TAXONOMIC CHARACTERS

The terminology of Blackwelder (1936) is used in the explanation of the characters that are employed in this taxonomic study. A discussion of those features that are significant for separation of species follows.

The length of the body was measured as the greatest distance from the anterior margin of the labrum to the apex of the ninth abdominal tergite. Approximations of the lengths were made when the abdomen was reflexed in dried, pinned specimens. Minimum and maximum lengths are stated for each species.

The color of the body ranges from deep ferrugineus to pale testaceus. Body color is not constant within a species; it is assumed that teneral specimens are of a different hue than mature forms, thus, color cannot be relied upon as a primary character. In sharpi, however, the three apical abdominal segments are consistently darker than the remainder of the abdomen (Figure 33).

A character diagnostic of Xenodusa is the frontal impression of the head--a concave depression posterad of the clypeus between the antennal fossae and ending immediately anterad of the occiput. The occipital suture is distinctly transverse and delineates the occiput posteriorly which is represented by a narrow raised band along the dorsum of the foramen magnum. The point at which the frontal impression

ends posteriorly on the epicranium is the vertex. The relative position of the vertex, i.e., either distinctly above the occiput or on the same level as the occiput in lateral view, is used in distinguishing between montana and reflexa (Figures 16 and 17, respectively).

The antennae of Xenodusa are 11-segmented and somewhat clavate. The basal segment is enlarged in all species. Segments 2-10 are similar to one another and are wide apically, narrowed basally, and longer than wide. The terminal antennal segment is longer than the other segments and is pointed apically. In Xenodusa caseyi, the terminal antennal segment is as long as the three preceding segments, whereas in Xenodusa angusta, which is very similar to caseyi, the terminal antennal segment is only as long as the two preceding segments.

The convex pronotal disk of Xenodusa occupies the entire dorsum of the prothorax. The anterior lateral angles are broadly rounded. The lateral margins are differentially reflexed among the species and have some diagnostic usefulness when specimens of different species are compared with each other. The thickness of the lateral reflexed rim of the pronotum can be used to separate the two subgenera of Xenodusa. The thick broadly rounded margins of Pseudolomechusa differs markedly from the narrow sharp margins found in Xenodusa sensu stricto. The inflexed portion of the pronotum known as the hypomera extends ventrally (Figures 3 and 4). A posterior projection on the margin of the hypomera is termed the pronotal lobe. The shape of the lobe and its position along the length of the hypomera is diagnostic for several species. The shape of the mesothoracic epimeron (Figures 1 and 2) is diagnostic in the separation of several species.

The legs of all species are long and slender. The shape of the femora varies in cross-section from round in sharpi and Pseudolomechusa to oval and compressed in Xenodusa sensu stricto.

The abdomen of Xenodusa, as in other staphylinids, is composed of 10 segments. Segments 3-7 are similar in structure, and possess one or two paratergites (=laterotergites) on the sides. The paratergites deviate from their usual structure in staphylinids, being modified to form the trichomes in Xenodusa spp., which are hairy structures important to the beetles' welfare in respect to its cohabitation with ants. In Xenodusa sharpi, the paratergites are developed into pronounced flanges (Figure 8).

The eighth and ninth segments are usually treated separately from the male genitalia, since they do not actually form any part of the genital tube. The ninth and tenth segments are modified to form the genitalia of the female. Blackwelder (1936) also has found this condition to be true of most other Staphylinids.

The eighth and ninth segments are modified in both sexes of Xenodusa. In the male, the posterior margin of the eighth sternite varies from broadly truncate to narrowly truncate among the species. The male ninth segment consists of a tergite with lateral pieces bearing long apodemes extending into the interior of the abdomen, and a sternite, or hypandrium (Crampton, 1938), which is slender and tongue-like. The apodemes of the lateral sclerites, which function as points of attachment for muscles of the gonobase, are not useful diagnostically, but are of the general structure as in Figures 22 and 23.

The posterior margin of the eighth sternite in the female, is rounded at the middle. The sternum of the ninth segment is composed of two separate sclerites united at the base, which were termed valvifers by Tanner (1927).

The male genital tube (sensu Sharp and Muir, 1912) as in Figure 24 consists of a large median portion composed of a sclerotized bulbous gonobase, and the aedeagus (=penis and penis valves--Lindroth, 1957, and Michener, 1944) at the distal end, and paired lateral lobes. On the venter of the gonobase is the median foramen (Sharp and Muir, 1912) through which the ejaculatory duct passes. The aedeagal foramen (Michener, 1944) is situated distad on the gonobase through which the aedeagus is extruded at the time of copulation. The membranous penis is surrounded on the dorsum by a pair of elongate sclerites, or penis valves (Michener, 1944). The penis valves of sharpi deviate from the usual structure (Figure 24) in Xenodusa sensu stricto being elongate crescent-shaped and widely separated sclerites (Figure 25). In Xenodusa sensu stricto, the penis valves are either straight and nearly contiguous sclerites as in montana, cava, and reflexa to basally fused sclerites in angusta and caseyi.

The paired lateral lobes (=parameres) are divided into two sections: the basal piece being the gonocoxite, and the distal part the gonostylus (Michener, 1944). There is a membranous lobe attached to the sclerotized gonostylus that can be extruded to better secure the female when mating. The apices of the gonostyli are clothed with short setae, and are diagnostic in as much as they vary from elongate lobes in sharpi, angusta, and caseyi to stout lobes in cava, reflexa, and montana. The inner face of the gonostylus is also sclerotized,

and on the distal aspect there is a delineated sclerotized, pigmented piece, the gonostylus plate (Figure 24), whose shape is characteristic from one species to the other.

Ventrad of the aedeagus, arising from the bulbous gonobase is a sclerotised projection that is large and longer than the aedeagus as seen from above in sharpi (Figure 25). This projection is less prominent and hidden from above by the aedeagus in the other species of Xenodusa.

The spermatheca is the most sclerotized part of the female genitalia and consists of a bulbous seminal vescicle and a highly convoluted tubule. Upon removing this structure from the end of the abdomen, it is covered with muscle and fatty tissue, thus obstructing the view of the convolutions of the tubule as well as the bulbous recepticle. Therefore, to remove this vexatious material, the spermathecae were boiled in 10% KOH solution for several minutes, but in so doing, either the seminal vescicle or the convoluted tubule became distorted from its true configuration.

SYSTEMATICS

Xenodusa Wasmann

Xenodusa Wasmann, 1894, Krit. Verz. 205.

[Type species: Atemeles cavus LeConte, fixed by subsequent designation (Fenyes, 1918, p. 26)]

Wasmann, 1896, Deut. Entomol. Z. 1896: 249.

Blatchley, 1910, Coleoptera of Indiana: 359.

Fenyes, 1918, Genera Insectorum 13: 305.

Blackwelder, 1952, Bull. U. S. Natl. Mus., No. 200: 406.

Body robust, depressed, parallel-sided; narrowed anterad and posterad. Color variable, usually ferrugineus or shades thereof. Length 4 to 6 mm.

Head small, parallel-sided, half as wide as base of prothorax; received in emargination along front margin of prothorax; frontal impression between antennal fossae. Occiput raised band along dorsum of foramen magnum. Mouthparts prognathous-type. Labrum visible from above, separate from clypeus; circular to transverse, with a strong fringe of long setae. Mandibles expanded basally, strongly curved distally into blunt point; inner margin simple with membranous prostheca. Maxilla comprised of basal cardo, stipes of two sclerites, galea, lacinia, and palpus; galea longer than lacinia; both lobes densely pubescent. Palpus 4-segmented; basal segment minute; segment

2 long, narrowed basally, incrassate apically; segment 3 slightly shorter than 2, narrow, cylindrical entire length; terminal segment short, acicular. Segments 2-3 with erect hairs; terminal segment bare. Gular sutures broadly separated. Mentum transverse, trapzoidal-shaped, broadly emarginate along front margin. Labial palpus 3-segmented; segment 2 slightly shorter and thinner than 1; segment 3 thin, acicular. Antennae 11-segmented; basal segment enlarged, incrassate; segment 2 as long or shorter than 3; segments 3-10 subequal, longer than wide, narrowed basally, wide apically; segment 11 longer than other segments, pointed at apex; all segments clothed with erect hairs. Eyes of moderate size; positioned laterally, oval-shaped, as long as tempora.

Prothorax wider than long; lateral margins strongly reflexed; front margin broadly emarginate; front angles broadly rounded; hind angles acute; basal margin broadly arcuate at middle. Hypomera broad in lateral aspect, with pronotal lobe along ventral margin (Figures 3 and 4). Prosternum with lateral lobes almost reaching inflexed pronotal margin. Procoxae conical, large, exserted; procoxal cavity broadly open behind; trochanter exposed, small, attached to truncated end of femur. Mesosternum truncate at apex attaining middle of mesocoxal cavity; mesocoxae rounded,broadly separated; trochanter as above; mesocoxal cavity closed. Metasternum large, convex; metasternal projection meeting mesosternal process (Figure 1); metacoxae transverse, contiguous; trochanter large.

Legs long, slender, setose; femora round to compressed in cross-section; tibia narrow, cylindrical, slightly curved at base, with two

apical spurs. Tarsi 4-5-5; tarsal segment 1 as long or longer than 2 and 3 together; tarsal claws simple.

Elytra as broad as base of prothorax; humeral angle broadly rounded; longer than prothorax. Scutellum visible from above, with dense mat of setae.

Abdomen as wide as apical margin of elytra; as long as prothorax and elytra; paratergites present on segments 2-7, with developed trichomes on paratergites 3-5 (Figures 8 and 9). Venter of abdomen convex, with or without erect setae. Abdomen narrowed from base to apex.

REMARKS. The genus Xenodusa may be readily distinguished from other genera of the Myrmedoniini of North America by the following combination of characters: robust, parallel-sided body, tufts of hair arising on sides of abdominal segments 3-6, and long, slender legs.

The subgenera Xenodusa sensu stricto and Pseudolomechusa can be separated by noting differences in the structure of the lateral margin of the pronota, and the male genital tubes.

Xenodusa species may be identified by characters of the male genitalia alone. This is not so with the females. Males may be separated from the females by the modified eighth and ninth abdominal sternites.

Most members of Xenodusa are found at the higher latitudes or higher elevations where conifers are abundant, since Formica spp., one of the hosts, usually provision their nests with coniferous debris, i.e., twigs and needles.

The earlier keys to the species of Xenodusa (Wasmann, 1896 and 1897) relied upon the relative shape of the pronotal disk, the lateral margin of the pronota, lengths of the antennal segments, and color as diagnostic features. The following key uses several of the above, but also relies heavily upon the configuration of the hypomera, vertex of the head, vestiture of the abdominal venter, and the male genital tube for the first time.

KEY TO THE TAXA OF NORTH AMERICAN XENODUSA

1. Lateral margins of pronotum thickened (Figure 33); penis valves widely separate, crescent-shaped; gonostylus plate as in Figure 25; south central Mexico . . . . . X. (Pseudolomechusa) sharpi Wasmann

   Lateral margins of pronotum not thickened. . (Xenodusa sensu stricto) 2

2. Body narrow; length 4 mm. or less; penis valves fused basally (Figures 24 and 26) 3

   Body not narrowed; size usually greater than 4 mm.; penis valves not fused basally, separate (Figures 27-29) 4

3. Terminal antennal segment as long as or slightly greater than the two preceding segments (Figure 19); shape of hypomera as in Figure 11; gonostylus plate as in Figure 24; extreme southwestern United States . . angusta (Fall)

   Terminal antennal segment as long as the three preceding segments (Figure 18); shape of hypomera as in Figure 13;

gonostylus plate shaped as in Figure 26; central Colorado . . . . . caseyi Wasmann

4. Venter of abdomen with long setae along caudal margins of sternites, or with scattered setae as well (Figures 5 and 6); shape of mesepimeron as in Figure 21 5

Venter of abdomen without long setae, only short pubescence; shape of mesepimeron as in Figure 20; gonostylus plate shaped as in Figure 27; East and Midwest states usually below 45° latitute . . . . cava (LeConte)

5. In lateral aspect, vertex of head distinctly elevated above the occiput (Figure 17); gonostylus plate as in Figure 29 . . . . . reflexa (Walker)

Vertex of head not elevated above occiput, but almost on same level (Figure 16); gonostylus plate as in Figure 28; California and southern Oregon . . . montana (Casey)

Subgenus Pseudolomechusa Mann

Xenodusa (Pseudolomechusa) Mann, 1914, Psyche 21: 174.

[Type-Species: Xenodusa sharpi Wasmann, by monotypy (Mann, 1914).]

Lateral margins of pronotum thickened. Paratergites of abdominal segments 3-5 highly developed, appearing as long flanges clothed with long hairs from above (Figure 8). Femora round in cross-section, no cavity along flexor margin for reception of tibia.

Male. Posterior margin of eighth sternite broadly truncate at the middle. Penis valves crescent-shaped and widely separated.

Projection of bulbous gonobase extremely long, surpassing the greatest length of aedeagus.

Female. Posterior margin of eighth sternite broadly rounded at the middle.

REMARKS. Xenodusa sharpi is the only known species of the subgenus Pseudolomechusa for North America. It occurs in south central Mexico.

Xenodusa (Pseudolomechusa) sharpi Wasmann

Figures 8, 10, 25, 33; Map 3

Xenodusa sharpi Wasmann, 1896, Deut. Entomol. Z. 1896: 251 [type locality, Cuernavaca, Mexico].

Mann, 1914, Psyche 21: 174.

Adults of sharpi are similar to the other Xenodusa species in general conspectus, but differ as follows:

Length 5.0-5.3 mm. Color of elytra golden-yellow. Head and pronotal disk browner than elytra. Antennal segment 2 as long as segment 3. Reflexed lateral margins of pronotum thick. Shape of hypomera as in Figure 10, with the pronotal lobe midway of the length of the structure. Dorsum and venter of abdominal segments 6-8 deep brown, that of segments 3-5 golden-yellow. Paratergites of segments 3-5 highly developed into flanges (Figure 8). Femora round in cross-section.

Male. Eighth sternite broadly truncated at apex with long setae along margin. Genital tube as in subgeneric discussion.

Female. Eighth sternite broadly rounded at the middle.

TYPE. No holotype designated. A cotype was seen from Wasmann's original material. It bears the following data: Cuernavaca, 7000', Flohr?, Aug. 1889/ Sharp Coll. 1905-313/ Xenodusa sharpi Wasm. Cotype. This cotype is deposited in the Field Museum of Natural History in Chicago.

DISTRIBUTION AND RECORDS. Xenodusa sharpi occurs in south-central Mexico. From the specimens at hand, this species can be collected during the months of July and August at the higher elevations. Forty-six specimens of sharpi have been examined.
MEXICO: Distrito Federal: Real de Arriba, VII. 32, 25.VII.32, 1.VII.32, 6300', H. E. Hinton (UASM, MCZC, USNM) 8♂, 1♀; Tejupilco, VII.32, 3960', H. E. Hinton (SEMC) 1♀, Hidalgo: Guerrereo Mill, W. M. Mann (USNM, MCZC, CASC, FMNH) 24♂, 6♀; San Miguel, W. M. Mann (FMNH) 2♂. Morelos: Cuernavaca, 7000', Flohr?, Aug. 1899 (FMNH) 1♂. Koltze, Mex. (FMNH) 2♂, 1♀. Country label only, "Coll. Kraatz" (CASC) 1♀.

REMARKS. Xenodusa sharpi is unlike any other species of Xenodusa. Mann (1914) proposed the subgenus Pseudolomechusa for sharpi, because of the differences in the pronotal structure and the larvae compared to that of Xenodusa sensu stricto.

Xenodusa sharpi possesses a pronotum with thick lateral margins, a structural feature which alone will separate it from Xenodusa sensu stricto.

Xenodusa sharpi has been collected in association with the following ants:

Camponotus auricomos Roger--from Cuernavaca, Mexico (Wasmann, 1896).

Camponotus maculatus var. picipes Olivier--from a canyon near Guerrereo Mill, Mexico (Mann, 1914).

Formica microgyna rasilis var. nahua Wheeler--from near Guerrereo Mill (Mann, 1914).

Formica rufibarbis gnava Buckley--from near Guerrereo Mill (Mann, 1914).

Subgenus Xenodusa sensu stricto

Xenodusa (Xenodusa) Wasmann, 1894, Krit. Verz.:205. [type-species: Atemeles cavus LeConte, from Pennsylvania, fixed by subsequent designation (Fenyes, 1918, p. 26).]

Lateral margins of pronotum not thickened, but with narrow sharp borders. Paratergites of segments 3-5 not developed into pronounced flanges (Figure 9). Femora vary from oval in cross-section as in angusta and caseyi to compressed in cava, reflexa, and montana.

Male. Posterior margins of eighth sternite broadly truncate at middle to narrowly truncate. Penis valves varying from nearly contiguous to fused basally. Projection of gonobase not long, hidden from above by aedeagus.

Female. Posterior margin of eighth sternite broadly rounded to bluntly pointed.

REMARKS. Species of this subgenus can be distinguished primarily by the thin lateral margins of the pronotum. This subgenus contains five species, all of which occur in North America, north of Mexico.

Xenodusa (Xenodusa) angusta (Fall)

Figures 11, 19, 24, 34; Map 3

Lomechusa angusta Fall, 1901, Occ. Pap. Calif. Acad. Sci. 8: 219 [type locality, Redondo, California].

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Fenyes, 1918, Genera Insectorum 13: 305.

Leng, 1920, Catalogue of the Coleoptera of America, north of Mexico: 116.

Length 4.0 mm. Body narrow. Color testaceus. Antennae 1/2 length of body. Terminal antennal segment slightly longer than segments 9 and 10 (Figure 19). Shape of hypomera as in Figure 11. Femora oval in cross-section.

Male. Posterior margin of eighth sternite narrowly truncate at the middle; margin with extremely long setae. Genital tube 0.9-1.20 mm long. Penis valves fused basally. Genostylus plate as in Figure 24.

Female. Posterior margin of eighth sternite rounded at apex with long setae.

TYPE. Lomechusa angusta Fall. Holotype, sex ?, with labels as follows: Redondo, California, 29 Mar/ Type # 24113. This specimen is deposited in the Museum of Comparitive Zoology, Harvard University.

DISTRIBUTION AND RECORDS. Xenodusa angusta occurs in the extreme southwest portion of the United States, from southern California to southern Arizona.

I have examined 5 specimens of angusta. UNITED STATES: Arizona: Cochise Co., Douglas, H. F. Snow (SEMC) 1♂; Santa Cruz Co., Nogales,

A. Koebele (CASC) 1♀; Catal Springs, 3.XII., Hubbard and Schwarz (FMNH) 1♂. California: Los Angeles Co., Pasadena, Feb., Davis (CASC) 2♀.

REMARKS. Xenodusa angusta is very similar to Xenodusa caseyi. The length of the terminal antennal segment and the shape of the hypomera as given in the key can be used to separate the two.

Camponotus (Myrmentoma) clarithorax Emery, which nests in oak galls in the southwestern states, is known to have been collected in association with angusta from Gran Arroyo Seco, Pasadena, California by A. Fenyes (Wheeler, 1911).

Formica pilicornis Emery is a possible summer host of angusta (Wheeler, 1911).

Xenodusa (Xenodusa) caseyi Wasmann

Figures 13, 18, 26, 35; Map 3

Xenodusa caseyi Wasmann, 1897, Deut. Entomol. Z. 1897: 273 [type locality, Canon City, Colorado].

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Fenyes, 1918, Genera Insectorum 13: 305.

Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 115.

Adults of caseyi are similar to angusta, but differ as follows:

Terminal antennal segment long, thin, as long as the three preceding segments (Figure 18). Shape of hypomera as in Figure 13.

Male. Posterior margin of eighth sternite narrowly truncate at the middle with erect setae along margin and a group of setae

(3 to 6) laterad. Genital tube 0.9 mm. Penis valves fused basally. Apices of gonostyli narrow, elongate. Gonostylus plate as in Figure 26.

Female. Posterior margin of eighth sternite broadly rounded at the middle with setal arrangement the same as in the male.

TYPE. No holotype designated. A cotype from Wasmann's original material was seen which came from Canon City, Colorado. This specimen is deposited at the United States National Museum. Data on the labels: Canon City, Col., 1900, Rev. F. Schmitt/ F. subpolita Mayr/ Xenodusa caseyi Cotype Wasm.

DISTRIBUTION AND RECORDS. Xenodusa caseyi occurs in the central portion of Colorado. Twenty-eight specimens of the species have been examined.

UNITED STATES: Colorado: Canon City, 1900, F. G. Schmitt, "Cotype" (USNM) 1 ♂; Canon City, III.08, F. G. Schmitt (CASC) 1 ♀ ; Canon City, Wickham (USNM) 1 ♂; Pueblo, Knaus (CASC) 2 ♂; State label only (MCZC, ICCM, CASC) 6 ♂, 5 ♀ .

REMARKS. Xenodusa caseyi was described by Wasmann from Colorado and all subsequent specimens examined were also from Colorado. However, a series of specimens of caseyi have been seen which were labeled from Jeanette, Pennsylvania, in the collection of the late H. G. Klages (ICCM). It is believed that these specimens were mislabeled. The specimens of caseyi at hand were not accompanied by any ants. Only one ant host has been recorded in the literature records with caseyi: Formica subpolita Mayr--P. M. Wirtner noted that this ant was collected with caseyi, according to Wasmann, 1897; also Wickham, 1902.

Xenodusa (Xenodusa) cava (LeConte)

Figures 7, 9, 12, 20, 27, 30; Map 2

Atemeles cavus LeConte, 1863, Smithsonian Misc. Col.: 30 [type locality, Columbia Co., Pennsylvania].

Gemminger and Harold, 1868, Catalogus Coleopterorum 2: 517.

Crotch, 1873, List of the Coleoptera of America, north of Mexico: 29.

Lomechusa cava (LeConte). Henshaw, 1885, List of the Coleoptera of America, north of Mexico: 31.

Xenodusa cava (LeConte), Wasmann, 1894, Krit. Verz.: 205.

Blatchley, 1910, Coleoptera of Indiana 1: 359.

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Fenyes, 1918, Genera Insectorum 13: 305.

Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 115.

Hatch, 1957, The Beetles of the Pacific Northwest. Part II. Staphyliniformia: 146.

Xenodusa reflexa (Walker). Fauvel, 1895, Rev. d'Entomol. 14: 8 [type locality, Vancouver Island].

Fenyes, 1918, Genera Insectorum 13: 305.

Xenodusa lobata Casey, 1911, Mem. of the Coleoptera 2: 71 [type locality, Iowa].

Fenyes, 1918, Genera Insectorum 13: 305.

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Xenodusa probata Casey, 1911, Mem. of the Coleoptera 2: 71 [type locality, Pennsylvania].

Fenyes, 1918, Genera Insectorum 13: 305.

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Xenodusa cava lobata (Casey). Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 115. [New Synonym].

Xenodusa cava probata (Casey). Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 115. [New Synonym].

Length varying from 4.8-6.4 mm. Head with vertex elevated behind frontal impression, above occiput. Antennae 1/2 to 3/4 length of body. Shape of hypomera as in Figure 12. Mesepimeron with little curvature, shaped as in Figure 20. Venter of abdomen devoid of long setae (Figure 7). Vestiture, if present, consists of short pubescence.

Male. Posterior margin of eighth sternite broadly truncate at the middle. Genital tube 1.5 mm long. Penis valves contiguous basally, more separated distally. Apices of gonostyli stout with few short setae. Gonostylus plate shaped as in Figure 27.

Female. Posterior margin of eighth sternite rounded at the middle.

TYPES. Atemeles cavus LeConte. Holotype, male, with labels: Columbia Co., Pennsylvania, Henderson, August/ Type # 6246. It is deposited in the collection of the Museum of Comparitive Zoology, Harvard University.

Xenodusa lobata Casey. Holotype, female, with the following data: Ia./ Casey bequest 1925/ Type # 39395/ lobata Casey. This specimen is in the collection of the United States National Museum.

Xenodusa probata Casey. Holotype, male, with labels as follows: St. Vinc, Penn./ Casey bequest 1925/ Type # 34396/ probata Casey. This type specimen is also in the USNM.

DISTRIBUTION AND RECORDS. Xenodusa cava occurs in the Midwest and eastern states from the Atlantic coast north to Massachusetts and Toronto, Ontario, west to the eastern portion of Colorado, and south along a line from northern Arkansas to northern South Carolina.

Over 400 specimens of cava have been examined.

Adults of this species have been collected throughout the year. Dr. Milton W. Sanderson has noted collecting a single specimen of cava in Illinois at a black light in July. This is the first mention of any Xenodusa spp. being attracted to black light.

REMARKS. Xenodusa cava was originally described as Atemeles cavus by LeConte in 1863. Casey (1911) described Xenodusa lobata from Iowa and Xenodusa probata from Pennsylvania. The types of cava, lobata, and probata have been examined and the morphological differences are within the range of variation, and are thus considered as representatives of the same species.

The following list of ant hosts was compiled from reviewing the literature and from the ecological data accompanying the specimens:

Camponotus americanus Mayr--Wheeler (1911) noted this ant to be host of cava at Norwood, Massachusetts.

Camponotus ferrugineus (Fabricius)--Wheeler (1911) found this ant with cava in Bloomington, Indiana (Wheeler, 1911); also accompanying some specimens on loan from London, Ohio, determined by Mary Talbot, 1931.

Camponotus noveboracensis (Fitch)--Found by Wheeler (1907) to occur with cava in Rockford, Illinois and Colebrook, Connecticut; by Wickham (1894) in Iowa City, Iowa; by

Muckermann (1904) at Prairie du Chien, Wisconsin; Blanchard (1879) at Tyngsboro, Massachusetts; Wasmann (1896); and Schwarz (1890).

Camponotus pennsylvanicus (DeGeer)--Found by Hamilton (1888) from Massachusetts; Wasmann (1896) in Massachusetts, Pennsylvania, Illinois, Iowa, and Michigan; Schwarz (1890) from Michigan; Wheeler (1910); these ants were also with specimens from Massachusetts and determined by Creighton, 1926.

Camponotus herculeanus herculeanus (Linnaeus)--This species determined by the author to occur with cava in Ohio.

Formica pallide-fulva nitidiventris Emery--Wheeler (1907, 1911) found this ant hosting cava at Colebrook, Massachusetts.

Formica rubicunda Emery--Found by Muckermann (1904) to occur with cava at Prairie du Chien, Wisconsin.

Formica schaufussi schaufussi Mayr--This species of Formica was noted to be a host (Muckermann, 1904).

Formica exsectoides Forel--According to McCook (1877), Dr. LeConte collected cava in the Allegheny Mountains of Pennsylvania with these ants.

Formica rufa subsp. ? --Hamilton (1888) and McCook (1877) noted that LeConte also collected cava with this ant in the Alleghenies.

Myrmica sp.--Determined by the author to occur with cava in Delaware Co., Ohio

Xenodusa (Xenodusa) reflexa (Walker)

Figures 5, 6, 15, 17, 21, 29, 31; Map 1

Atemeles reflexus Walker, 1866, In Lord, The Naturalist in Vancouver Island and British Columbia 2: 317 [type locality, Vancouver Island].

Gemminger and Harold, 1868, Catalogus Coleopterorum 2: 518.

Atemeles cavus LeC. var. hirsutus Wasmann, 1893, Deut. Entomol. Z., 1893: 102 [new synonym].

Xenodusa reflexa (Walker), Wasmann, 1894, Krit. Verz.: 205.

Fauvel, 1895, Rev. D'Entomol. 14: 8.

Wasmann, 1896, Deut. Entomol. Z., 1896: 250.

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Fenyes, 1918, Genera Insectorum 13: 305.

Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 116.

Hatch, 1957, The Beetles of the Pacific Northwest. Part II. Staphyliniformia: 146.

Xenodusa montana (Casey) var. hirsuta Wasmann, 1896, Deut. Entomol. Z. 1896: 251 [new synonym].

Length 4.8 mm. Color ferrugineius to testaceus. Head with vertex elevated above occiput in lateral aspect (Figure 17). Hypomera shaped as in Figure 15. Mesepimeron with acute angle on mesal border as in Figure 21. Dorsum of abdomen with some short setae along apical margins, and sub-opaque in appearance. Venter of abdomen with erect setae on apical margins of sternites only, OR erect setae along margins of sternites as well as scattered setae (Figures 5 and 6).

Male. Posterior margin of eighth sternite similar to cava, but more broadly truncate. Genital tube 1.5-2.0 mm long. Penis valves long, slender, and contiguous at base. Apices of gonostyli stout with few short setae. Gonostylus plate shaped as in Figure 29.

Female. Posterior margin of eighth sternite bluntly pointed at the middle.

TYPE. Atemeles reflexus Walker. The author did not examine the type specimen. It is in the collection of the Hope Department of Entomology, University of Oxford.

DISTRIBUTION AND RECORDS. Xenodusa reflexa occurs across continental North America primarily in the North. It ranges from New England states across the Canadian provinces to British Columbia with southern extensions into the mountains of Arizona and New Mexico (Map 1). Over 200 specimens of reflexa were examined.

REMARKS. Xenodusa reflexa is very similar to Xenodusa montana. The structure of the vertex of the head differs between the two, with it being distinctly elevated above the occiput in reflexa and on the same level as the occiput in montana.

At the onset of this study, forms were separated on the basis of morphological uniqueness. Two morphological forms were discerned in eastern and northern North America. A midwestern and eastern form was found to be Xenodusa cava after examining the type specimen of cava. The remaining form, primarily northern in its range across North America, is ascribed to Xenodusa reflexa. The type locality of reflexa is Vancouver Island, which falls nicely in the range of this population. The type specimen of reflexa has not been examined, and the original description was virtually useless, but the author

is confident that the species reflexa, described from Vancouver Island, is the same form which occurs across northern North America.

Wasmann described hirsutus as a new variety of cava in 1893. Leng (1920) listed Michigan as the main distribution of hirsuta. Wasmann's actions in the 1890's concerning his treatment of hirsuta, gives the author a better perspective of the issue. Wasmann (1896), only three years after his decision to call hirsuta a variety of cava, decided to call hirsuta a variety of montana after the examination of the types. Xenodusa montana, however, occurs only in the far West, not in Michigan. Being that reflexa resembles montana, and the above assertions, the variety hirsuta should be synonymized with reflexa.

The range of Xenodusa reflexa is not distinctly separate from that of cava, but overlaps along a narrow band from northern Illinois through lower Michigan to Massachusetts.

Large numbers of reflexa were collected in Mason and Wexford Counties of upper Michigan with Camponotus noveboracensis (Fitch). C. noveboracensis also appears with other specimens of reflexa across its range. Nests of Formica obscuripes obscuripes Forel in close proximity of C. noveboracensis in Wexford County yielded no adult beetles at that time of the season when the adults supposedly migrate to Formica spp. Xenodusa reflexa has been found also with the following hosts:

Camponotus ferrugineus (Fabricius)--Determined by the author to occur with beetles in Massachusetts.

Formica sp.--With a beetle from Massachusetts.

Xenodusa (Xenodusa) montana (Casey)

Figures 14, 16, 28, 32; Map 3

Lomechusa montana Casey, 1886, Bull. Calif. Acad. Sci. 2: 202 [type locality, Nevada Co., California].

Xenodusa montana (Casey), Wasmann, 1894, Krit. Verz.: 205.

Wasmann, 1896, Deut. Entomol. Z. 1896: 251.

Bernhauer and Scheerpeltz, 1926, Coleopterorum Catalogus 5: 711.

Fenyes, 1918, Genera Insectorum 13: 305.

Leng, 1920, Catalog of the Coleoptera of America, north of Mexico: 115.

Xenodusa montana closely resembles Xenodusa reflexa, but differs as follows:

Length 4.5-5.0 mm. Color testaceous to pale ferrugineous. Head with vertex not distinctly elevated above occiput in lateral aspect, but on same level as occiput, thus making frontal impression appear more extensive. Vestiture on dorsum of abdomen similar to reflexa, only with fewer setae. Appearance of abdominal dorsum glabrous, shiny.

Male. Posterior margin of eighth sternite broadly truncate. Genital tube 1.5-2.0 mm long. Penis valves separate elongate sclerites. Apices of gonostyli stout. Gonostylus plate shaped as in Figure 28.

Female. Posterior margin of eighth sternite broadly rounded.

TYPE. Lomechusa montana Casey. Holotype, male, with the following labels: Cal./ Type 39397/ Atemeles montana Casey/ Casey bequest 1925. This type specimen is in the Casey collection at the United States National Museum.

DISTRIBUTION AND RECORDS. Xenodusa montana occurs in California and southern Oregon.

UNITED STATES: California: Alpine Co. (CASC) 8♂; El Dorado Co. (UCDC, CASC, MCZC, UMIC) 17♂, 16♀; Lassen Co. (CASC, CUIC, UASM) 30♂; Madera Co. (CASC, CNCI, ICCU) 2♂, 1♀; Placer Co. (UCDC) 1♂; Santa Clara Co. (CASC, CNCI) 28♂, 26♀; Shasta Co. (CASC, MCZC, UBCZ) 5♂, 2♀; Sierra Co. (UCDC) 6♂, 6♀; Siskiyou Co. (CASC, MCZC) 7♂, 4♀; Tulare Co. (UCDC) 6♂, 6♀; Tuolumne Co. (UCDC) 2♂, 1♀; Sisson, Cal. (CASC) 1♀; Tallac, Cal. (CASC) 1♂. Oregon: Klamath Co., Bly Mtns., 25.IV.58, J. Schuh (MSUC) 1♂, 2♀.

REMARKS. Xenodusa montana is very similar in appearance to Xenodusa reflexa. The one concrete character that can be used to separate the two is the vertex of the head, i.e., distinctly elevated in reflexa but not in montana (Figure 16).

The ant hosts of montana are the following:

Camponotus laevigatus F. Smith--From California (Wasmann, 1896); Schwarz, 1890; occurs with montana at Castle Crag, McCloud, and Sissons, California (Wheeler, 1911); also with montana in Facht, Cal., determined by the author.

Camponotus herculeanus modoc Wheeler--Occurs with montana in Tahoe City, California (Wheeler, 1911).

Formica subpolita Mayr--P. M. Wirtner, according to Wasman (1897), stated he found this ant with montana.

INCERTAE SEDIS

Atemeles cavus LeC. var. major Wasmann

Wasmann (1899) described major as a variety of cava. He collected specimens with Camponotus pennsylvanicus (DeGeer) at Cromwell, Connecticut. The type specimen is presumably in a museum in Europe, probably in Vienna, and unfortunately was not available for study. Two possible species (reflexa and cava) can occur in that area of Connecticut. The original description gives no idea as to which species Wasmann collected in August of 1899. Therefore, at the present, the status of var. major will remain undecided.

Atemeles cavus LeC. var. major Wasmann, 1899, Deutsche Entomol. Ztschr., 1899: 410 [type locality, Cromwell, Connecticut].

Host: Camponotus pennsylvanicus (DeGeer).

PLATE I

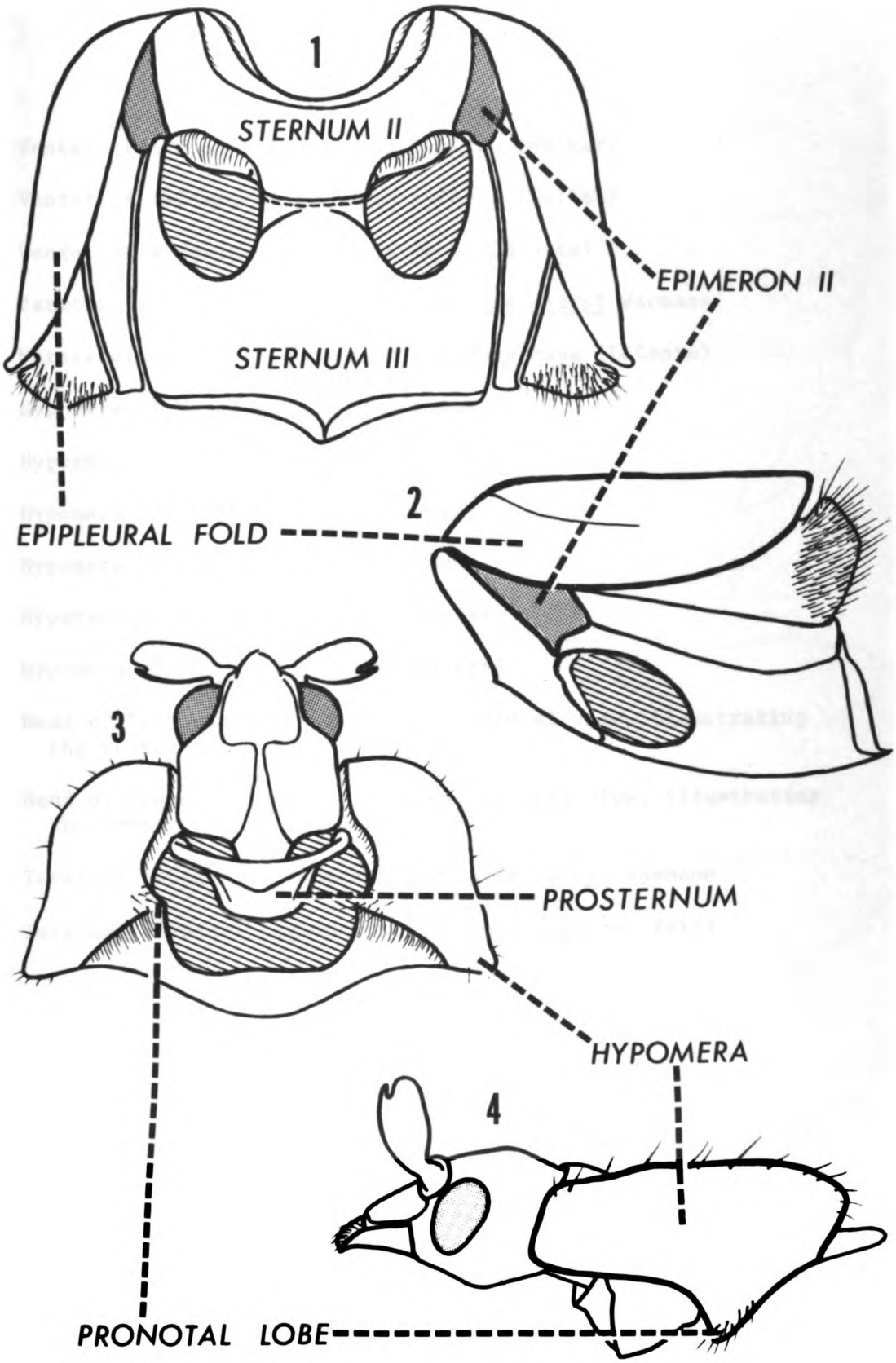
Figures

1. Structure of the mesothoracic and metathoracic sterna and pleura, ventral view--X. reflexa (Walker)

2. Same as Figure 1, lateral view

3. Structure of the prothoracic sternum--X. reflexa (Walker)

4. Same as Figure 3, lateral view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STERNUM II
STERNUM III
EPIMERON II
EPIPLEURAL FOLD
2
3
PROSTERNUM
HYPOMERA
4
PRONOTAL LOBE

PLATE II

Figures

5. Venter of abdomen of Xenodusa reflexa (Walker)

6. Venter of abdomen of Xenodusa reflexa (Walker)

7. Venter of abdomen of Xenodusa cava (LeConte)

8. Paratergites and trichomes of Xenodusa sharpi Wasmann

9. Paratergites and trichomes of Xenodusa cava (LeConte)

10. Hypomera of Xenodusa sharpi Wasmann

11. Hypomera of Xenodusa angusta (Fall)

12. Hypomera of Xenodusa cava (LeConte)

13. Hypomera of Xenodusa caseyi Wasmann

14. Hypomera of Xenodusa montana (Casey)

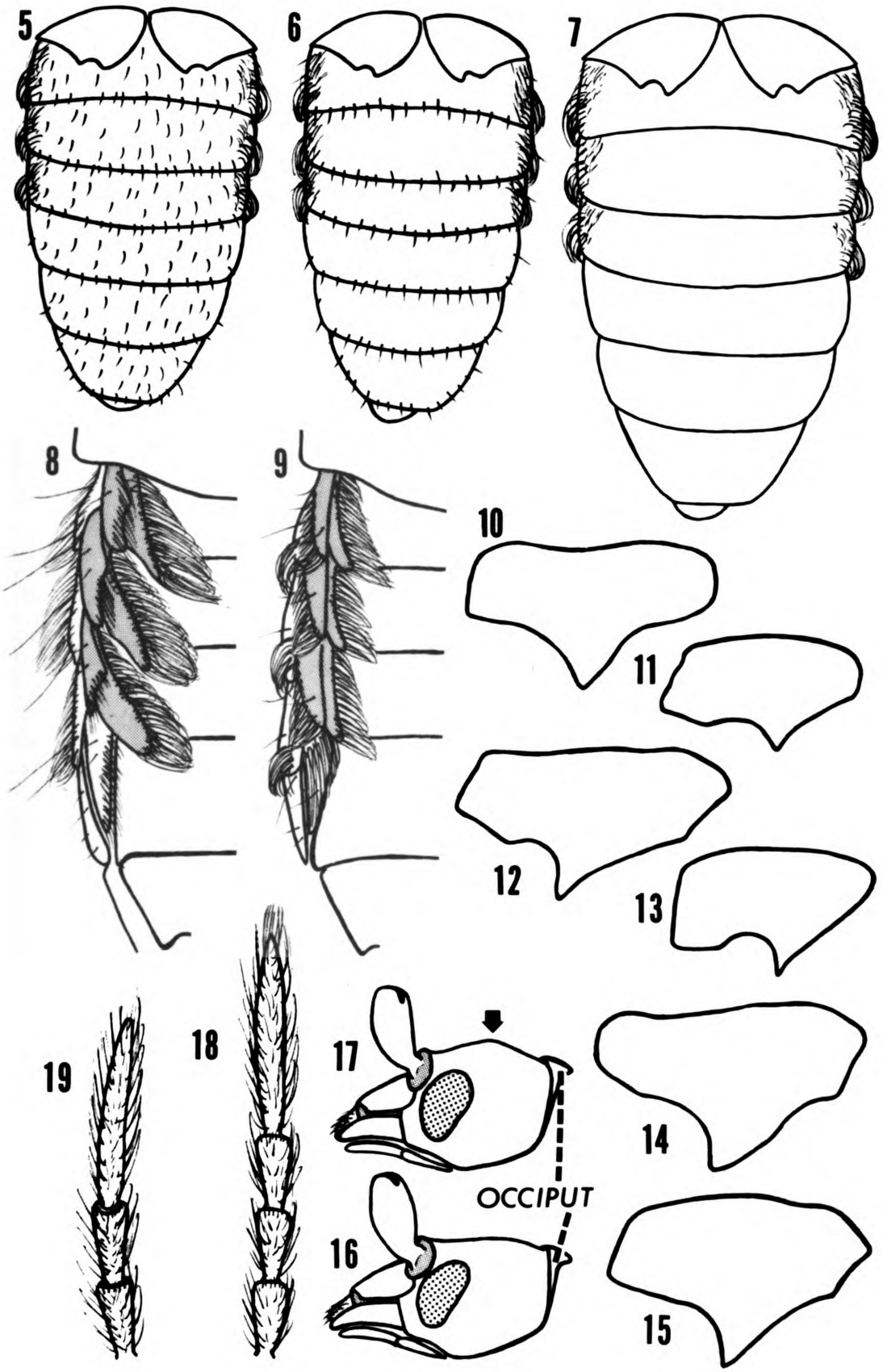
15. Hypomera of Xenodusa reflexa (Walker)

16. Head of Xenodusa montana (Casey), lateral view, illustrating the vertex

17. Head of Xenodusa reflexa (Walker), lateral view, illustrating the vertex

18. Terminal antennal segments of Xenodusa caseyi Wasmann

19. Terminal antennal segments of Xenodusa angusta (Fall)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OCCIPUT

PLATE III

Figures

20. Mesepimeron of Xenodusa cava (LeConte)

21. Mesepimeron of Xenodusa reflexa (Walker)

22. Ninth tergite and lateral pieces bearing apodemes of Xenodusa spp.

23. Same as Figure 22, lateral view

24. Genital tube of Xenodusa angusta (Fall)

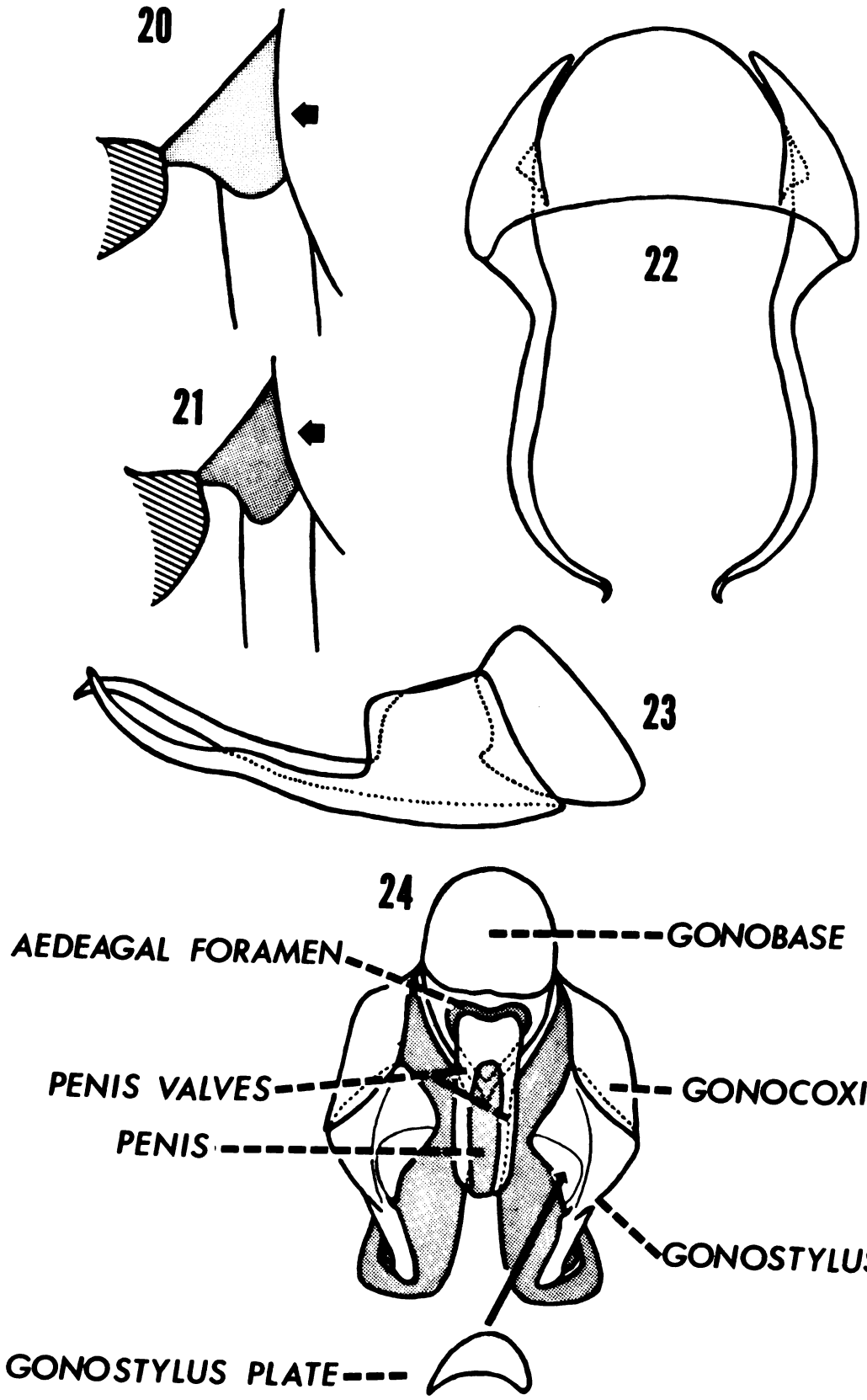
20
21
22
23
24
AEDEAGAL FORAMEN
GONOBASE
PENIS VALVES
GONOCOXITE
PENIS
GONOSTYLUS
GONOSTYLUS PLATE

PLATE IV

Figures

25. Genital tube of Xenodusa sharpi Wasmann

26. Genital tube of Xenodusa caseyi Wasmann

27. Genital tube of Xenodusa cava (LeConte)

28. Genital tube of Xenodusa montana (Casey)

29. Genital tube of Xenodusa reflexa (Walker)

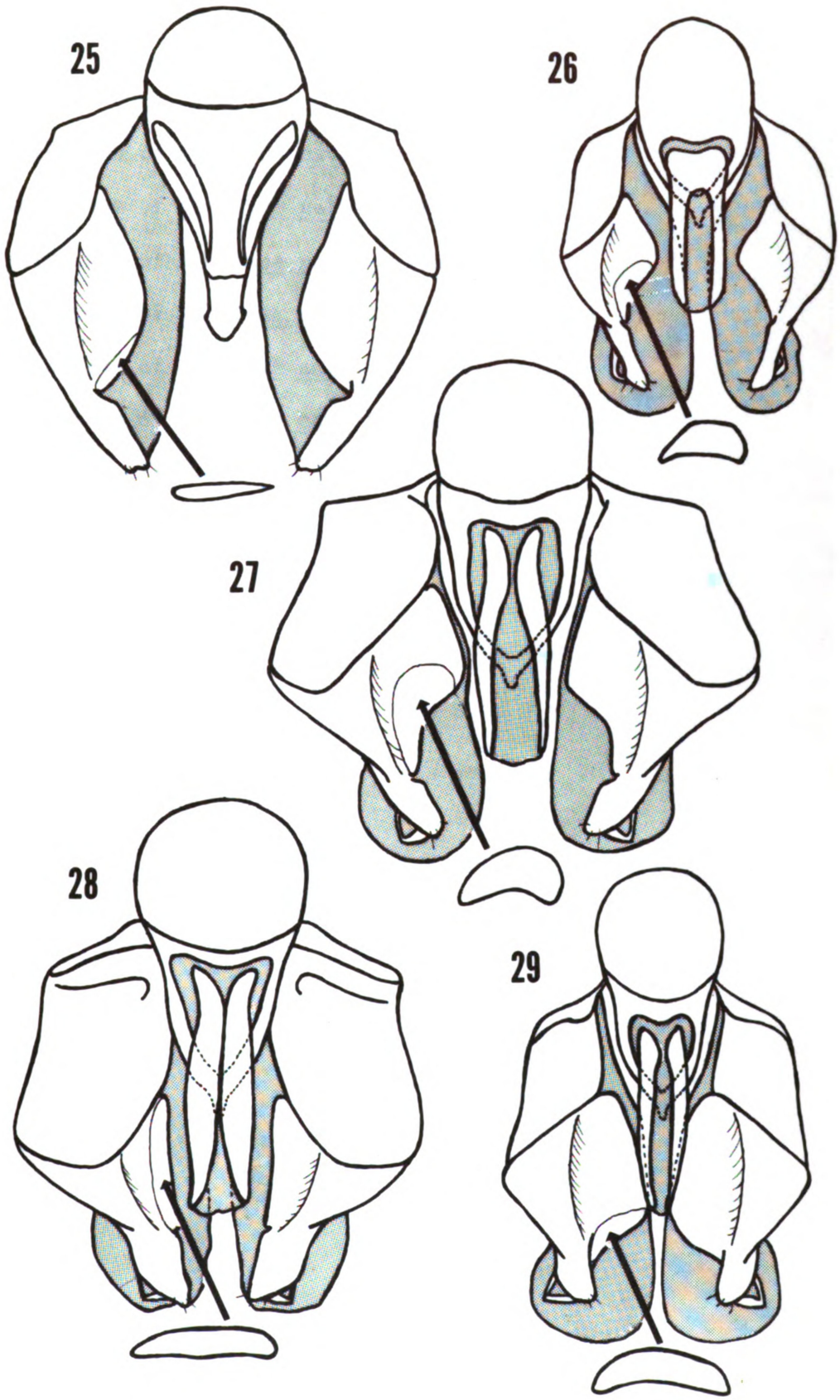
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PLATE V

Figures

30. Photograph of Xenodusa cava (LeConte)

31. Photograph of Xenodusa reflexa (Walker)

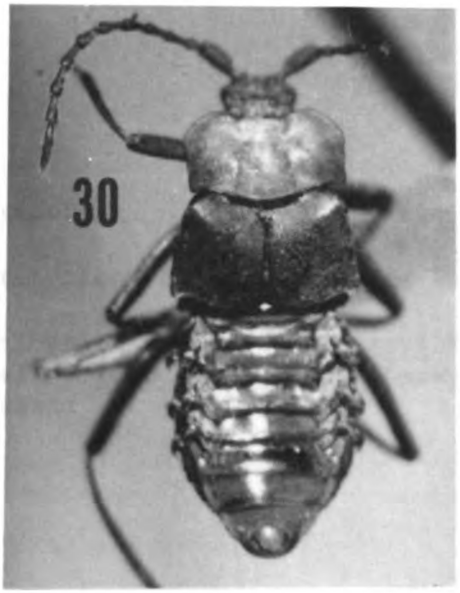
32. Photograph of Xenodusa montana (Casey)

33. Photograph of Xenodusa sharpi Wasmann

34. Photograph of Xenodusa angusta (Fall)

35. Photograph of Xenodusa caseyi Wasmann

Photos by Richard A. Arnold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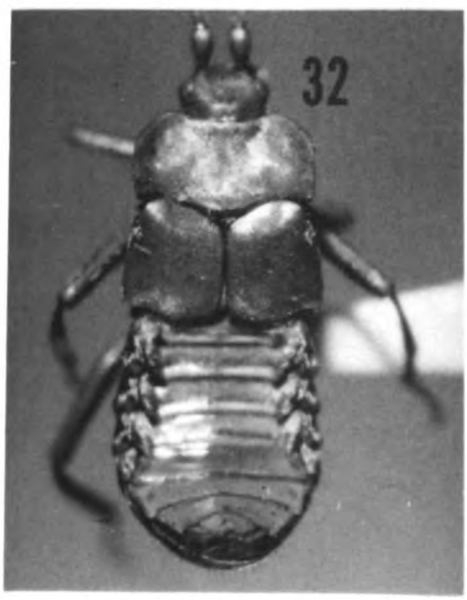
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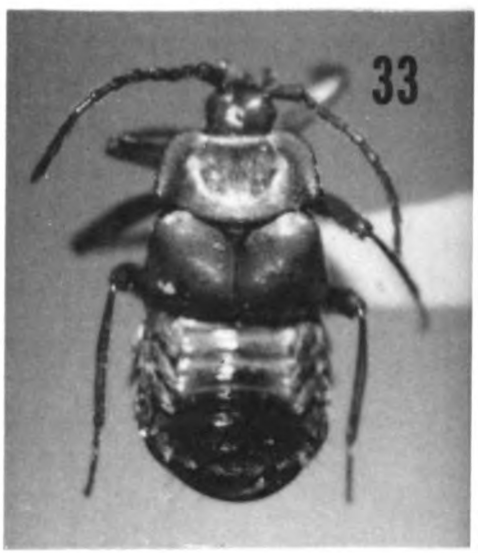
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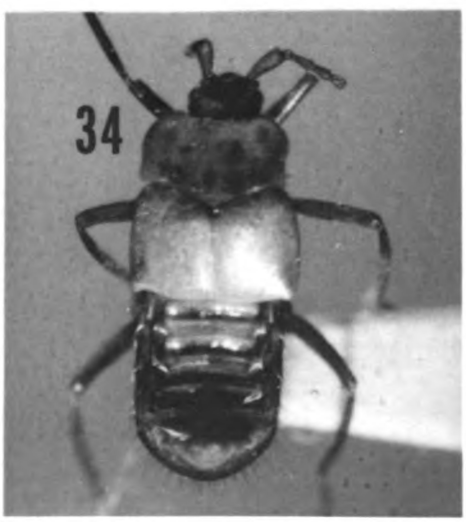
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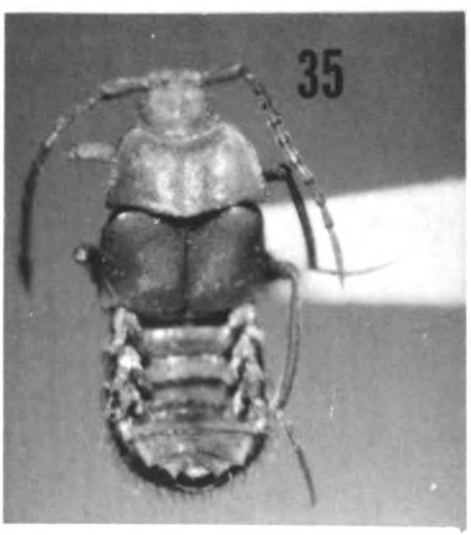
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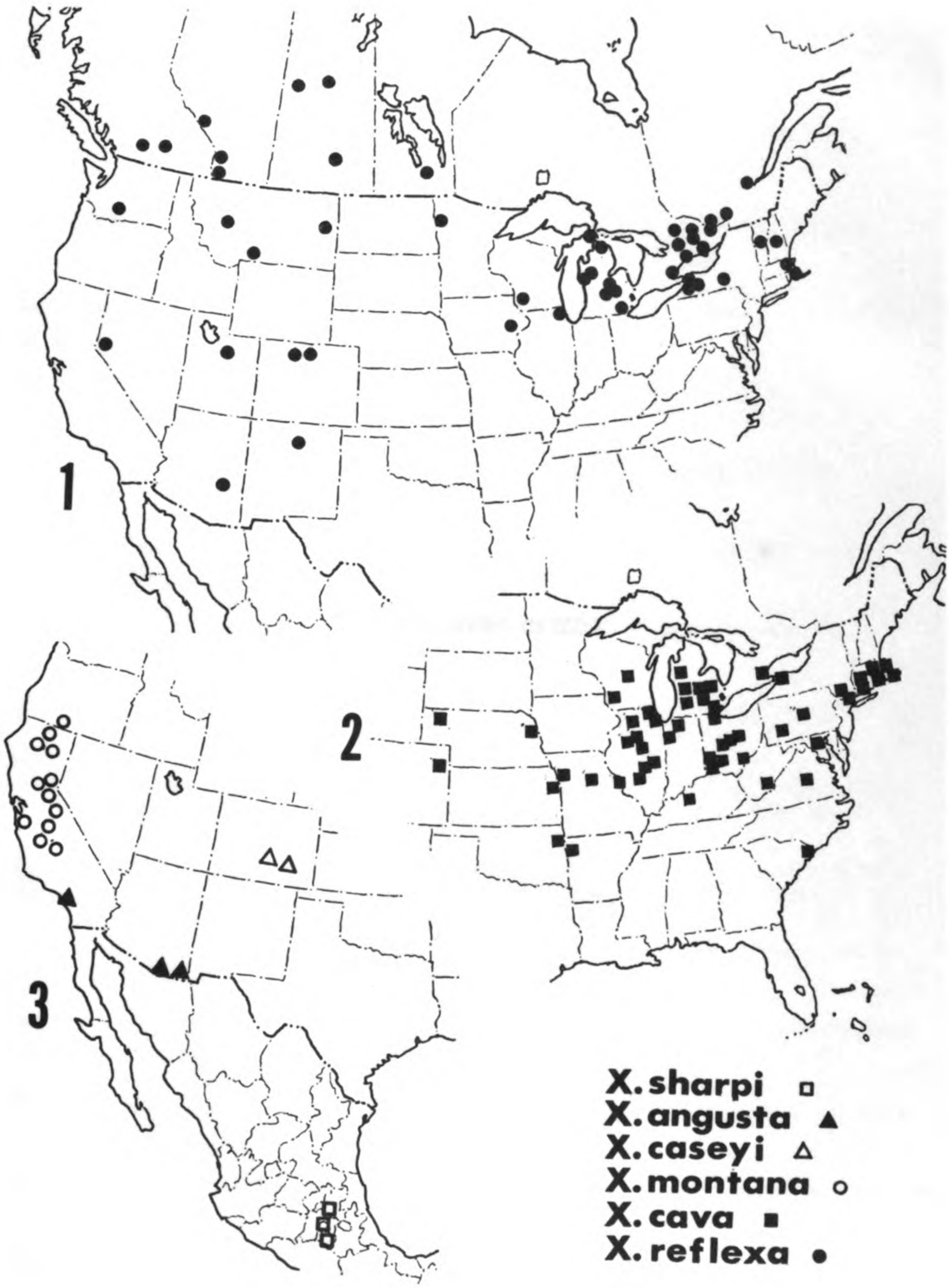
PLATE VI

Maps

1. Distribution of Xenodusa reflexa (Walker)

2. Distribution of Xenodusa cava (LeConte)

3. Distribution of Xenodusa caseyi Wasmann, Xenodusa angusta (Fall), Xenodusa montana (Casey), and Xenodusa sharpi Wasmann


1
2
3
X. sharpi
X. angusta
X. caseyi
X. montana
X. cava
X. reflexa

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LITERATURE CITED

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