

## Revision of the genus *Boettcheria* in America North of Mexico (Diptera: Sarcophagidae)

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Key Words: Diptera, Sarcophagidae, *Boettcheria*, Systematics

**Abstract:** The seven Nearctic species of *Boettcheria* are revised and distributional data are given for North America. Both sexes can be identified from the key. Bionomic information is included. *Boettcheria pugetensis* Dodge, 1967 is placed as a junior synonym of *B. melanderi* Dodge, 1967 (NEW SYNONYM), and a lectotype is designated for *B. cimbicis* (Townsend). *B. mexicana* Lopes is recorded from the Nearctic region for the first time.

### Introduction

The genus *Boettcheria* contains some of the most commonly collected sarcophagids in North America. Seven of the twenty-five described species can be found in the Nearctic region, while the other eighteen are Neotropical in distribution. A catalog of the names and type localities of the species in this genus was given by Pape (1989), with the exception of *B. melanderi* Dodge, which should be added to this list. Lopes (1950) provided the most recent revision of this genus, but he included no key for the identification of the species and included few descriptions of the females.

Members of the genus *Boettcheria* can be found in a wide variety of habitats, from old growth forest to the yards and parks of urban areas. Males are more often collected than females, as is generally the case for station-taking species.

A wide variety of rearing records exist for the North American species. *Boettcheria cimbicis* (Townsend) and *B. litorosa* (Reinhard) have been reared from Hymenoptera, *B. cimbicis* and *B. latisterna* Parker have been reared from a variety of Coleoptera and Lepidoptera, and a few Orthoptera.

Many of the rearing records report members of this genus as parasitoids on their respective hosts, but this may be misleading. Most of the records do not include any information regarding the protec-

tion of caged "hosts" from possible attack from sarcophagids on dead or dying individuals within the cages. *Sarcophaga crassipalpis* Macquart has been observed to larviposit through the screening of rearing cages containing decaying materials (personal observations); Graenicher (1935) noted the ability of *S. bullata* Parker and *S. bishoppi* Aldrich to larviposit through a very narrow space between a glass cover and rim of a fruit jar containing a portion of a dead snake. Campbell (1963) noted that the sarcophagids apparently parasitic in gypsy moth were actually scavengers, taking advantage of moth puparia previously stung by ichneumonid wasps.

In addition to insect hosts, several species have been reared in the laboratory on hamburger and/or liver. *Boettcheria cimbicis* and *B. latisterna* do not deposit larvae on hamburger, but are easily reared on it (Knipling 1936, personal observations). The larvae of these species, if present in sufficient numbers, significantly suppress the normal decay odors of hamburger (personal observations)

### Materials and Methods

This revision is based on an examination of more than 3000 specimens, including the primary types of *B. bisetosa*, *B. cimbicis*, *B. fernaldi*, *B.*

*latisterna*, *B. litorosa*, *B. melanderi*, *B. pugetensis*, and *B. siccana*. The terminology follows that of McAlpine *et al.* (1981) for general morphology, and Roback (1954) for the aedeagus. Locality records indicated on the maps only represent records from specimens actually seen by the authors while the records given under the "distribution" heading for each species also include what appear to be reliable locality records from the literature. Acronyms for specimen depositories are included in the acknowledgements. All genitalic figures are of aqueous-mounted, cleared (in hot KOH solution), dissected specimens. Membranous aedeagal structures may appear different in dried specimens.

### Genus *Boettcheria* Parker

*Boettcheria* Parker, 1914: 65. Type species, *Boettcheria latisterna* Parker, 1914 by original designation.

**Generic diagnosis:** This genus may be separated from other Nearctic sarcophagid genera by a combination of the following features: postalar wall bare; costa with an irregular ventral row of setae extending from base to, or just past,  $R_1$  (Fig. 1); long set of setae of lower calyptral fringe extending to posterolateral corner (Fig. 2).

**Description. Male:** Medium to large sarcophagids (6-18 mm); dark bluish gray in overall color with silvery tessellated pattern on dorsum of abdomen. Compound eye with ommatidia equally spaced and of equal size. Posterior ocelli separated by 1/2 distance to anterior ocellus, forming an isosceles triangle. Ocellar setae reduced, 2 thin proclinate setae near anterior ocellus and a scattering of very small setae present in the ocellar triangle. Inner vertical seta large and slightly reclinate. Outer vertical seta not differentiated. Parafacial pruinose with a row of thin setae. Rows of frontal setae strongly divergent at level of pedicel, convergent dorsad of frontal suture and gradually diverging dorsally. Vibrissae located at level of oral margin, very strong and convergent. Flagellum 3X length of pedicel. Arista medium plumose on basal 3/5 with ventral plumosity extending beyond dorsal plumosity. Genal groove bare. Palpus black and slightly clubbed. Prementum darkly sclerotized, not pruinose, with a few long, thin setae on posterior surface.

Prosternum slightly spatulate. Scutum with 3 dark vittae; 2 primary and 2 subprimary notopleural setae; 3 presutural dorsocentral setae; usually with well-differentiated presutural acrostichal se-

tae; 3 postsutural dorsocentral setae; 2 postalar setae; intrapostalar setae absent; basal, marginal, discal, subapical, and apical scutellar setae present; 1 large proepisternal seta; 2 dorsal katepisternal setae, usually a third present between them; postalar setae absent.

Abdominal tergum 3 with 2 lateral marginal setae. Tergum 4 with 2 median marginal setae and 2-3 lateral marginal setae. Tergum 5 with a marginal row of setae. Fifth sternum with a broad, deep cleft posteriorly, generally forming a V, with an open, central window. Sternum 6 asymmetrical and reduced. Genital segments orange. Gonopod 1-segmented, bare of setae, directed anteriorly and, generally, pointed apically. Paramere 2-segmented; apical segment much larger than basal segment, usually broad basally and narrowing to a hook apically; 1 strong seta present near anterior edge. Aedeagus symmetrical; vesica large, trilobed, and complex; juxta well developed; median process and lateral filaments distinctly formed; basiphallus and distiphallus fused anteriorly and hinged posteriorly. Surstylus variable, but shorter than cercus and with some setae. Cercus with conspicuous basal tuft of long, thin setae.

Wing hyaline. Tegula black. Basicosta bare; amber in color. C continues to  $M_{1+2}$ , with irregular ventral row of setae extending to or just past  $R_1$ .  $R_1$  not setulate. Dorsal setae present on  $R_{4+5}$  from Rs extending a length approximately equidistant to Rs length.  $M_{1+2}$  ending in C before wing tip. Slight infuscation present at r-m crossvein.  $M_3+Cu_1$  bare. Long set of setae of lower calyptral fringe extending to posterolateral corner.

Profemur with a row of anterodorsal setae, a row of posterodorsal setae and a posteroventral row of long setae. Propretarsal claws reduced and covered with dense golden setae. Metacoxa with 1 large seta on the apex of the posterior margin and with a group of setae on the ventral edge. Metatrochanter with a brush-like clump of short, stubby spines on the anteroventral surface (Fig. 3) and with a row of strong setae on the posterior surface (Fig. 4). Metafemur with anterodorsal, anterior, anteroventral setae, the anterior setae as large or larger than the setae in the other 2 rows; a ventral fringe of long thin setae present.

**Female:** Compound eyes more widely separated than in the male; ocellar triangle equilateral with 2 large proclinate ocellar setae. Outer vertical setae present and diverging; 2 proclinate orbital setae. Upper orbital seta reclinate. Scutellum without apical scutellar setae. Abdominal tergum

4 with 2 extra pairs of marginal setae. Abdominal sternum 5 entire. Sterna 6, 7, and 8 form independent plates with many thin setae; sternum 8 usually smaller in width than 6 or 7 and tapering to blunt point. Sternum 9 lightly sclerotized with or without darkly sclerotized patches. Sternum 10 unsclerotized; with apical thin setae. Cercus lightly sclerotized with apical long, thin setae. Spermathecae elongated, transversally striated, and usually somewhat trilobed with the central lobe largest and the spermathecal tube extending from a smaller end lobe. Accessory glands nearly spherical, unpigmented and with a muscular duct which empties into a usually unpigmented pouch along with the spermathecal tubes. Propretarsal claws well developed. Metatrochanter without the clump of short, stubby setae on the anteroventral surface. Metafemur without anterior row of setae and without ventral fringe of long setae.

#### Key to species of *Boettcheria*

1. Males ..... 2  
 — Females [female of *B. melanderi* unknown] ..... 8
- 2(1). Presutural acrostichal setae absent; 2 katepisternal setae; gonopod rounded at apex (Fig. 11), basal segment of paramere large, over 1/2 the size of the apical segment (Fig. 11); vesica elongate and directed posteriorly in lateral view (Fig. 9), with the outer membranous lobes much larger than the central sclerotized lobe in anterior view (Fig. 10) ..... *bisetosa* Parker  
 — Presutural acrostichal setae present; 3 katepisternal setae; gonopod pointed at apex, basal segment of paramere 1/3 the size of the apical segment, or less (Figs. 21, 31, 41, 52, 57, 67); vesica not elongate and directed posteriorly in lateral view (Figs. 19, 29, 39, 55, 65), except for *B. melanderi* (Fig. 49) where the outer membranous lobes are not distinctly larger than the central sclerotized lobe in anterior view (Fig. 50) ..... 3
- 3(2). Metafemur with anterodorsal, anteroventral and anterior setae, concentrated on apical half (Fig 6); apical segment of paramere not abruptly expanded dorsally (Fig. 31); vesica very complex and elongated anteriorly with lateral filaments long and conspicuous (Fig. 29); cerci elongate, separated by approximately 1/4 length of entire cerci (Fig. 34) .... *B. latisterna* Parker  
 — Metafemur with a complete anterodorsal and anterior row of setae, metafemur setae not concentrated on apical half (Fig. 5); apical segment of paramere abruptly expanded dorsally (Figs. 21, 41, 52, 57, 67); vesica not elongated anteriorly and with the lateral filaments not extending much, if at all, ventral of juxta; cerci with a more extensive separation, extending 1/3 to 1/2 length of entire cerci (Figs. 24, 44, 54, 60, 70) ..... 4
- 4(3). Fifth abdominal tergum orange; vesica, in lateral view, with sharp projections anterodorsally (Fig. 65) ..... *B. praevolans* (Wulp)  
 — Fifth tergum black; vesica without such projections ..... 5
- 5(4). Vesica elongate, directed posteriorly in lateral view (Fig. 49); cerci much longer than wide (Fig. 54) ..... *B. melanderi* Dodge  
 — Vesica not elongate, directed anteroventrally or ventrally in lateral view (Figs. 19, 39, 55); cerci nearly as wide as long (Figs. 24, 44, 60) ..... 6
- 6(5). Juxta with laterally projecting processes in posterior view; central lobe of vesica curved on the sides, with sharp, lateral marginal points in anterior view (Fig. 40); cerci with basal hump-like projections (Fig. 44) ..... *B. litorosa* (Reinhard)  
 — Juxta without laterally projecting processes; central lobe of vesica rounded laterally, without sharp points in anterior view (Figs. 20, 56); cerci without basal hump-like projections (Figs. 24, 60) ..... 7
- 7(6). Fifth sternum with 2 darkened, scale-like, posteromesal projections (Fig. 22); central lobe of vesica thinner and shorter than the convoluted outer membranous lobes in anterior view (Fig. 20) ..... *B. cimbicis* (Townsend)  
 — Fifth sternum without such scale-like projections (Fig. 58); central lobe of vesica as wide or wider than outer membranous lobes in anterior view (Fig. 56) ..... *B. mexicana* Lopes
- 8(1). Presutural acrostichal setae absent; 2 katepisternal setae; width of sternum 7 approximately 3 X length; sternum 8 as wide as sternum 7 and broadly rounded, distinctly longer than sternum 7 (Fig. 18) ..... *B. bisetosa* Parker  
 — Presutural acrostichal setae present; 3 katepisternal setae; either sternum 7 not 3 X as long as wide or sternum 8 not so expanded (Figs. 28, 38, 48, 64, 73) ..... 9
- 9(8). Fifth abdominal tergum orange; sternum 8 broad, with a pair of small, lateral projections basally (Fig. 73) ..... *B. praevolans* (Wulp)  
 — Fifth abdominal tergum black; sternum 8 bluntly pointed apically and without basal lateral projections (Figs. 28, 38, 48, 64) ..... 10
- 10(9). Posterior surface of mesofemur evenly gray and pruinose (Fig. 7); sternum 9 present as an

- evenly and lightly sclerotized plate (Fig. 27)...  
 ..... *B. cimbicis* (Townsend)
- Posterior surface of mesofemur with a medial area bare of pruinosity, often reddish in color (Fig. 8); sternum 9 present as an evenly and lightly sclerotized plate (Figs. 47, 63) or with darkly pigmented patches (Fig. 37) ..... 11
- 11(10). Sternum 9 with darkly pigmented patches (Fig. 37)..... *B. latisterna* Parker
- Sternum 9 evenly and lightly sclerotized (Figs. 47, 63) ..... 12
- 12(11). Sternum 8 distinctly narrower at base than width of sternum 7, with shallow posterior mesal indentation (Fig. 48).. *B. litorosa* (Reinhard)
- Sternum 8 approximately as wide at base as sternum 7, with posterior mesal indentation extending 1/4 to 1/3 the total length of sternum 8 (Fig. 64) ..... *B. mexicana* Lopes

***Boettcheria bisetosa* Parker**  
 (Figures 9-18, Map 1)

- Boettcheria bisetosa* Parker 1914: 45, 47, 69-72, figures 35, 48; type locality: Amherst, Massachusetts?; male holotype (description). Lopes 1950: 698, 722-723, figures 52-56 (redescription). Roback 1954: chart 8, figures 341-343 (phylogeny, male genitalia). Judd 1956: 403 (biology, locality record). Pape 1989: 433 (included in redefined genus).
- Sarcophaga bisetosa* Aldrich 1916: 74, 81, figure 29 (key, redescription, male genitalia). Greene 1925: 5, 16, figure 24 (key, description of puparium). Wilson 1932: 84, 89 (biology). Winn and Beaulieu 1932: 81 (locality records). Brown 1934: 250 (locality records). Felt and Chamberlain 1935: 63 (biology, locality records). Parish and Cushing 1938: 755 (biology, locality record). Strickland 1938: 215 (locality record). Hallock 1940a: figures 17-19 (male genitalia). Hallock 1940b: 201, 204, 209, 213, 218-219, figures 103-105 (keys, redescription, male genitalia). Sanjean 1957: 15, 39, 40, 41, 52, figures 88-96, tables 1, 4-5, 7, 9-15 (biology, keys for larvae, description of larvae). Cole and Schlinger 1969: 501 (locality records).

**Description. Male.** Total length 11-14 mm. Presutural acrostichal setae absent, usually with 3 postsutural dorsocentral setae. Katepisternum with only 2 setae, the middle seta absent. Fifth sternum with 2 broad posterior mesal flaps (Fig. 12). Aedeagus curved posteriorly (Fig. 9); vesica distinctly trilobed, the outer membranous lobes much larger than the central sclerotized lobe; central lobe of vesica abruptly curved dorsally at apex (Fig. 10).

Gonopod rounded at apex (Fig. 11). Basal segment of paramere over 1/2 the size of the apical segment (Fig. 11). Surstyli tuberculate; blunt apically (Fig. 13). Cerci not much longer than broad; median cleft broadly diverging in apical half (Fig. 14).

**Female.** Total length 9-15 mm. Usually with 2 postsutural dorsocentral setae, the posterior seta absent. Posterior surface of mesofemur with a medial area bare of pruinosity, often reddish in color. Sternum 7 approximately 3X as wide as long; sternum 8 as wide as sternum 7 and broadly rounded, distinctly longer than sternum 7 (Fig. 18). Sternum 9 with small patches of dark sclerotization. Sternum 10 usually without long setae (Fig. 17). Cerci small, distinctly narrowed anteriorly and with apical setae. Spermathecae darkly sclerotized and trilobed. Spermathecal tube very long and unsclerotized, abruptly narrowing near apex (Fig. 16). Accessory glands membranous (Fig. 15).

**Diagnosis.** The lack of presutural acrostichal setae and the presence of only 2 katepisternal setae separate this species from all others. The aedeagus of this species is very similar, in lateral view, to *B. melanderi* but can be separated by the anterior view of the aedeagus and by the shape of the fifth sternum. The shape of the seventh and eighth sterna separates the female of this species from all others.

**Distribution.** Canada: Manitoba, Ontario, Quebec; U.S.A.: Arkansas, Connecticut, Florida, Georgia, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, West Virginia.

Cole (1969) referred to Hall and Reinhard determinations of specimens from California, but no specimens of *B. bisetosa* from California have been seen by us. Parish and Cushing (1938) report the capture of one specimen from Menard County, Texas. We have not seen specimens collected in Texas.

**Type.** Holotype male in collection of the University of Massachusetts. Type locality: not given in original description and the only label on type is the initials M.A.C. (=Massachusetts Agricultural College?) (Amherst, Massachusetts).

**Discussion.** Sanjean (1957) successfully reared this species on pork liver and described the first, second, and third instar larvae. His one group of rearings, at 27°C, produced the following means and ranges for the life stages: 1 (1) day for first instar; 1 (1) day for second instar; 16.5 (14-19) days for third instar; 10 (8-11) days for pupa; 28.5 (24-32)

days for all stages. He noted that the length of the third instar in *B. bisetosa* is much longer, comparatively, than other species of Sarcophagidae that he reared. Eight larvae were removed from, or deposited by, one female. Greene (1925) described the puparium.

One specimen was reared from "4.[...]juttivitta" (not interpreted) (UNH). No collector was given on the data label.

One male specimen from Florida was observed by us that had bright orange legs (FSCA). This condition is commonly seen with specimens of *B. latisterna* from Florida.

The highest elevation indicated on a collection label for a member of this species is 4782 feet from Mt. Enotah in Georgia (USNM). Felt and Chamberlain (1935) collected *B. bisetosa* on top of a fire tower in Rensselaer County, New York. The elevation of the site was 1960 feet and the tower had a height of 60 feet. They also collected this species on the roof of the State Education Building in Albany, New York. They noted that the building is 128-148 feet above street level and considerably higher than the tops of adjacent trees.

*Boettcheria bisetosa* has been collected in a Malaise trap and in a window trap. Wilson (1932) reported occasionally collecting this species near sheep dung from May to September in a New Jersey sheep pasture. Sanjean (1957) collected 1 gravid female, 1 nongravid female, and 1 male during the latter part of 1951 and throughout 1952. All three specimens were collected on a stone wall. None were collected at baits. Parish and Cushing (1938) collected one specimen of *B. bisetosa* in a trap baited with lean beef in water in Menard County, Texas during 1931. Judd (1956) collected one specimen in a trap baited with a malt extract in London, Ontario during 1953.

*Boettcheria bisetosa* is typically found in woodland areas. Males are often found taking stations on leaves or logs in the morning in direct sunlight. This species is normally found at ground level up to 1 m and is commonly collected sitting on the bare ground in patches of sunlight on woodland trails (personal observations).

***Boettcheria cimbicis* (Townsend)**  
(Figures 1-2, 5, 7, 19-26, Map 2)

*Sarcophaga cimbicis* Townsend 1892: 126-127; type locality: Brookings, South Dakota; lectotype (here designated) male and female paralectotype (description). Coquillett 1892: 23 (biology). Johnson 1895: 334 (locality record). Kelly 1914: 439, 441, 445

(biology). Aldrich 1915: 243, 244 (misidentifications, biology). Aldrich 1916: 74, 79-81, figure 28 (key, redescription, male genitalia). Gibson 1916: 216 (locality records). Hayes 1917: 260 (biology). Gibson 1918: 119 (locality records). Davis 1919: 116-117 (biology). Sherman 1920: 299 (biology). Britton 1920: 196 (locality record). Sherman 1921: 480 (biology). Cole and Lovett 1921: 306 (locality record). Cole 1923: 208 (classification). Shannon (1923): 104 (biology). Porter and Alden 1924: 31 (biology). Reinhard 1924: 128 (locality record). Breakey 1929: 460, 461-62 (biology). Crumb 1929: 40, 94 (biology). Hall 1929: 83, 85 (biology). Hallock 1929: 247 (biology). Curran 1930: 89 (locality record). Breakey 1931: 44 (biology). Decker 1931: 345 (biology). Decker 1932: 509 (biology). Wilson 1932: 84, 89 (biology). Winn and Beaulieu 1932: 81 (locality records). Brown 1934: 250 (locality records). Felt and Chamberlain 1935: 63 (biology, locality records). Bruce and Knipling 1936: 364 (biology). Knipling 1936: 419, 425, 427, 428, 444, figures 18 or 19 (figure legend and text reference do not match), 60, 77, 91 (biology, description of larva). Hallock 1937: 261 (locality records). Parish and Cushing 1938: 755 (biology, locality record). Strickland 1938: 215 (locality record). Hallock 1940a: 130, figures 20-22 (biology, male genitalia). Hallock 1940b: 201, 203, 204, 209, 214, 219, figures 106-108 (keys, biology, male genitalia). Adams 1941: 73 (locality record). Smith *et al.* 1943: 374 (biology). Woodbury 1943: 72 (biology). Simmonds 1944: 223 (biology). Thompson 1944: 35 (biology). Merrill and Hutson 1953: 678 (biology). Downes 1955: 522, 532 (morphology). Sanjean 1957: 7, 16, 39, 40, 41, 50-52, figures 79-87, tables 1-7, 9-15 (biology, keys for larvae, description of larvae). Byers *et al.* 1962: 162 (location of types). Cole and Schlinger 1969: 501 (locality records).

*Sarcophaga setulosa* Wulp 1896: 276; type locality: Durango, Mexico; male holotype (description). Aldrich 1930: 32 (synonymy). Emden 1950: 196, 197, 199 (biology).

*Boettcheria fernaldi* Parker 1914: 45, 47, 72-74, figures 36, 47. Type locality: Hatch Experiment Station (Amherst, Massachusetts?) (description). Aldrich 1916: 79-81 (synonymy).

*Boettcheria cimbicis*; Parker 1917: 280-281 (biology, locality record). Lopes 1950: 699-702, 724-726, figures 57-65 (redescription). Roback 1954: chart 8, figures 337-340 (phylogeny, male genitalia). Judd 1956: 403 (biology, locality record). Boyes 1963: 1200-1201, 1203, figures 14, 29, table I-II (description of karyotype). Rummel and Knapp 1970: 169, table 1 (biology). Judd 1970: 189 (biology, locality record). Greenberg and Ash 1972: 1345, figure 31 (morphology). Peckham *et al.* 1973: 652 (biology). Anderson and Kaya 1976: 171, table 2 (biology). McAlpine *et al.* 1987: figure 111 (larva). Pape 1989: 433 (included in redefined genus).

**Description. Male.** Total length 7-12 mm. Fifth sternum with 2 conspicuous, darkly sclerotized, posteromesal flaps (Fig. 22). Aedeagus with vesica distinctly trilobed, in anterior view; the outer membranous lobes larger than the central sclerotized lobe (Fig. 20). Gonopod with blunt apex but with a small, apical tuberculate point (Fig. 21). Basal segment of paramere approximately 1/3 the size of the apical segment. Apical segment of paramere resembles the larger portion of a crayfish's cheliped; with one large seta (Fig. 21). Surstyli with an acute bend near midpoint (Fig. 23). Cerci small, separated approximately 1/2 the total length (Fig. 24).

**Female.** Total length 6-10 mm. Mesofemur with posterior surface pruinose (Fig. 7). Sterna 6 and 7 subequal in size. Sternum 8 bluntly heart shaped (Fig. 28). Sternum 9 present as a lightly sclerotized, single plate without patches of dark sclerotization (Fig. 27). Sternum 10 with long, thin setae at apex. Cercus small; with thin, apical setae. Spermathecae darkly sclerotized and slightly trilobed with spermathecal tubes unsclerotized, abruptly narrowing near apex (Fig. 26). Accessory glands membranous (Fig. 25).

**Diagnosis.** Males that have not had their genitalia spread can usually be separated by the conspicuous posteromesal flaps of the fifth sternum (Fig. 22). Most females can be separated by the presence of pruinosity on the entire posterior surface of the mesofemur (Fig. 7).

**Distribution.** Canada: Alberta, Manitoba, Nova Scotia, Ontario, Quebec, Saskatchewan; U.S.A.: Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Texas, Utah, Vermont, Virginia, Wisconsin.

Records from California, Idaho, and Washington given by Aldrich (1916), Cole and Lovett (1921), and Cole and Schlinger (1969) are probably based on misidentifications of *B. litorosa*.

**Type.** Male and female syntypes of *B. cimbicis* in the Snow Entomological Museum (University of Kansas). Type locality: Brookings, South Dakota. Both were reared from cocoons of *Cimbex americana* (Hymenoptera: Cimbicidae). The male specimen is here designated as the lectotype and the female specimen is designated as a paralectotype.

**Discussion.** *Boettcheria cimbicis* is the most commonly collected species of *Boettcheria* and is also one of the most commonly collected Sarcophagidae in its range.

Shannon (1923) reared this species on nutrient agar made up of beef infusion from one pound of hamburger and 3% agar and water added to make one liter.

Knipling (1936) reared this species on decomposing hamburger and described the first instar larvae. He collected 21 larvae from one female and reported a developmental period of 21 days.

Sanjean (1957) reared this species on pork liver and described the first, second, and third instar larvae. He reared several groups of larvae at three different temperatures. His three groups of rearings at 27°C produced the following means and ranges for the life stages: 1.3 (1-2) days for first instar; 1 (1) day for second instar; 5 (4-8) days for third instar; 11 (10-14) days for pupa; 18.3 (16-25) days for all stages. His one group of rearings at 25°C produced the following means and ranges for the life stages: 1 (1) day for first instar; 1 (1) day for second instar; 5.2 (4-9) days for third instar; 9 (7-10) days for pupa; 16.2 (13-21) days for all stages. His one group of rearings at 23°C produced the following means and ranges for the life stages: 1 (1) day for first instar; 1 (1) day for second instar; 5 (3-8) days for third instar; 11 (11) days for pupa; 18 (16-21) days for all stages. He reports no difficulty in rearing several generations of this species and notes that, at 25°C, flies mated at 5 days and larviposited at 13 days after emergence. An isolated female, at 25°C, produced a second brood 8 days after deposition of the first larvae; at 23°C, another isolated female produced a second brood 6 days later. A range of 4-16 and mean of 10 larvae were removed from, or deposited by, four females.

Townsend (1892) described this species from two specimens, one male and one female, which emerged from a pupa of the willow sawfly, *Cimbex americana* Leach (Hymenoptera: Cimbicidae).

Kelly (1914) reported rearing this species from large nymphs and adults of the grasshoppers *Chortophaga viridifasciata* De Geer, *Melanoplus differentialis* (Thomas), and *M. bivittatus* (Say) (Orthoptera: Acrididae). Note: these rearing records from grasshoppers may be erroneous, since Aldrich was involved with the initial identifications yet did not mention these rearing records in his discussion of this species in 1916 and noted that references in the literature between 1892 and 1914 may be based on misidentifications. Aldrich (1915) also mentioned

the problem of misidentifications of specimens as *cimbicis*.

This species has been reported as a parasitoid of the adults of several scarab beetles: the May beetles *Phyllophaga futilis* (LeConte), *P. lanceolata* (Say), *P. implicita* (Horn), *P. rugosa* (Melsheimer), *P. crassissima* (Blanchard) (Hall 1929) and *Phyllophaga* sp. (= *Lachnosterna* sp.) (Davis 1919; Emden 1950); the rhinoceros beetle *Xyloryctes satyrus* (Fabricius) (= *X. jamaicensis* Drury) (Hallock 1929; Emden 1950); and the carrot beetle *Ligyryus gibbosus* De Geer (Hayes 1917; Hall 1929).

Sherman (1920) recorded *B. cimbicis* as a pupal parasitoid of the green cloverworm, *Plathypena scabra* Fabricius (Lepidoptera: Noctuidae). *Boettcheria cimbicis* is also noted as a larval parasitoid of the iris borer, *Macronoctua onusta* Grote (Breakey 1929, 1931), the stalk borer, *Papaipema nebris* (Guenee) (Decker 1931), and the dark-sided cutworm, *Euxoa messoria* (Harris) (Crumb, 1929) (Lepidoptera: Noctuidae); the bidens borer, *Epiblema otiosana* (Clemens) (Decker 1932) (Lepidoptera: Olethreutidae); and the elm spanworm, *Ennomos subsignarius* (Hubner) (Anderson and Kaya 1976) (Lepidoptera: Geometridae). There is a possible record of it as a parasitoid of the fall cankerworm, *Alsophila pometaria* (Harris) (Porter and Alden 1924; Sherman 1921; Thompson 1944) (Lepidoptera: Noctuidae).

Peckham *et al.* (1973) reported that the solitary wasp *Oxybelus uniglumis quadrinotatus* Say (Hymenoptera: Sphecidae) provisions its nests with *B. cimbicis*, along with other flies representing 11 families of Diptera. All sarcophagids found as nest provisions of this wasp were males.

One female specimen, collected by A.L. Melander in New York, is noted as being "from box turtle" (USNM).

Judd (1956) collected 72 males and 33 females in traps baited with a malt extract in London, Ontario during 1953. Wilson (1932) reported occasionally collecting this species near sheep dung from May to September in a New Jersey sheep pasture. *Boettcheria cimbicis* has been collected in cone type, screen fly traps baited with pork liver in the vicinity of Ames, Iowa (Bruce and Knipling 1936). Adults have been trapped and/or netted in Michigan onion fields (Merrill and Hutson 1953). *Boettcheria cimbicis* represented 1.25% of the total male sarcophagids collected by Rummel and Knapp (1970) in modified USDA fly bait traps in Kentucky. They were collected only during April from traps that were baited with sheep or horse liver. Parish

and Cushing (1938) collected *B. cimbicis* in traps baited with lean beef and water in Menard County, Texas. Parker (1917) collected one specimen in a trap baited with beer in Laurel, Montana. Sanjean (1957) collected 5 gravid females and 56 males of *B. cimbicis* during the latter part of 1951 and throughout 1952 in the Ithaca, New York area. Five specimens were collected at the following baits: horse dung (2), hog liver (2), and freshly killed American cockroaches (1). The remaining 56 specimens were collected at the following resting sites: stone wall (33), field stones (20), tree trunks (1), and on vegetation in fields (2). *Boettcheria cimbicis* has been collected on opossum dung in Connecticut (USNM) and on cabbage roots in Pennsylvania (USNM). It has also been collected on sand dunes (UMinn), on alfalfa (UMinn), on red clover (UMinn), on sweet clover (UMinn), and on parsnip (UMinn). Judd (1970) collected *B. cimbicis* in a baited trap set out on the *Sphagnum* mat of Byron Bog in southwestern Ontario.

One male specimen from Chihuahua, Mexico, was collected on flowers of smooth sumac, *Rhus glabra* at 7300 feet (USNM). This specimen's altitude information represents the highest noted elevation that this species has been collected. The highest U.S. elevation record belongs to a male specimen from Arizona at 6000 feet (SEM). Felt and Chamberlain (1935) collected *B. cimbicis* on top of a fire tower in Rensselaer County, New York. The elevation of the site was 1960 feet and the tower had a height of 60 feet. They also collected this species on the roof of the State Education Building in Albany, New York (with *B. bisetosa*).

*Boettcheria cimbicis* is usually found in relatively open sites, being collected commonly in urban and suburban areas. Males of this species often take stations on green leaves or logs in the morning in direct sunlight. This species is also commonly found taking stations during mid to late afternoon. In suburban settings, males are found taking stations much more commonly on backyard structures, such as sheds or a child's playhouse, than on the walls of larger structures, such as houses. This species is usually found from ground level up to 2 m (personal observations).

Boyes (1963) described the 6 pairs of chromosomes composing the karyotype of *B. cimbicis* and compared this species' karyotype with other species of Sarcophagidae.

Greenberg and Ash (1972) described and provided an SEM photograph of the setiferous plaques on the antennal pedicel of *B. cimbicis* and compared their

appearance with several other sarcophagid species and species within other families of muscoid Diptera.

***Boettcheria latisterna* Parker**

(Figures 6, 8, 29-38, Map 3)

*Boettcheria latisterna* Parker 1914: 41, 47, 67-69, figures 9a, 21, 34, 49; type locality: Manchester, Vermont; male holotype (description). Crampton 1944: 14, 19-20, figure 45 (male genitalia). Lopes 1950: 688-690, figures 1-7 (redescription). Roback 1954: chart 8, figures 346-349 (phylogeny, male genitalia). Judd 1956: 403 (biology, locality record). Judd 1970: 189 (biology, locality record). Payne and King 1972: 160 (biology). Allen 1972: 1619, table 1 (biology). Lopes 1975: 163 (morphology). Evans *et al.* 1980: 867 (biology). O'Brien and Kurczewski 1980: 672 (biology). Pape 1989: 433 (included in redefined genus).

*Sarcophaga latisterna*: Aldrich 1916: 74, 77-78, figure 26 (key, redescription, male genitalia). Gibson 1919: 117 (locality records). Britton 1920: 196 record). Sherman 1921: 480 (biology). Phillips and King 1923: 12 (biology). Porter and Alden 1924: 31 (biology). Greene 1925: 5, 18, figure 31 (key, description of puparium). Chittenden 1926: 6 (biology). Breakey 1929: 460, 462 (biology). Crumb 1929: 40, 94 (biology). Hall 1929: 87 (locality record). Hallock 1929: 246-250 (biology, description of larva). Breakey 1931: 44 (biology). Knull 1932: 1202 (biology). Winn and Beaulieu 1932: 81 (locality records). Knipling 1936: 419, 427, 428, 443-444, figures 18 or 19 (figure legend and text reference do not match), 44 (biology, description of larva). Hallock 1937: 261 (locality records). Strickland 1938: 215 (locality record). Clausen 1940: 427 (biology). Hallock 1940a: 130, figures 23-25 (biology, male genitalia). Hallock 1940b: 201, 204, 208, 214, 218, 219-220, figures 109-111 (keys, biology, male genitalia). Bibby 1942: 943 (biology). Thompson 1944: 35 (biology). Emden 1950: 195, 197, 198, 199 (biology). Merrill and Hutson 1953: 678 (biology). Downes 1955: 532 (classification). Sanjean 1957: 7, 39, 40, 41, 52, tables 1, 4-7, 9-15 (biology, keys for larvae, description of larvae). Cole and Schlinger 1969: 502 (locality record).

*Sarcophaga latisterna irrisoris* Reinhard 1952: 142 (description). Byers *et al.* 1962: 163 (location of types).

**Description. Male.** Total length 9-14 mm. Anterodorsal, anterior, and anteroventral setae of metafemur concentrated on apical half (Fig. 6). Fifth sternum with a large central window and without posteromesal flaps; inner mesal lobes darkly sclerotized (Fig. 32). Aedeagus directed anteriorly; corpus with 2 thin lateral lobes; vesica elongate, multilobed, with only 2 small outer membranous

lobes apically; lateral filaments very long, extending well past ventral margin of aedeagus; juxta triangular, with a small, sharp projection near anteroventral margin (Figs. 29-30). Gonopod smoothly tapering to an apical point (Fig. 31). Apical segment of paramere not abruptly broadened basally (Fig. 31). Surstylus long, thin, darkly sclerotized apically (Fig. 33). Cercus elongate and separated from other cercus in apical 1/3 of length; apical points divergent (Fig. 34).

**Female.** Total length 8-11 mm. Posterior surface of mesofemur with a medial area bare of pruinosity, often reddish in color (Fig. 8). Dark setae present on ventral side of lower calypter near the anterolateral corner. Sterna 6 and 7 subequal in size and approximately 3X wider than long. Sternum 8 bluntly heart shaped (Fig. 38). Sternum 9 with patches of dark pigmentation. Sternum 10 with a few long, thin setae near apex (Fig. 37). Cercus with strong apical setae. Spermathecae darkly sclerotized and distinctly trilobed with spermathecal tubes unsclerotized; abruptly narrowing apically, with a sharp bend near midlength (Fig. 36). Accessory glands membranous (Fig. 35).

**Diagnosis.** Males that have not had their genitalia spread can usually be separated by the concentration of the anterodorsal, anterior, and anteroventral setae on the apical half of the mesofemur (Fig. 6). Most females can be separated from the similar species *B. cimbicis* by the medial area without pruinosity on the posterior surface of the mesofemur (Fig. 8). Females collected from western localities will need to be dissected to separate them from *B. litorosa*. The patches of dark pigment on sternum 9 (Fig. 37) separate *B. latisterna* from *B. litorosa*.

**Distribution.** Canada: Alberta, British Columbia, Manitoba, Northwest Territories, Nova Scotia, Ontario, Quebec; U.S.A.: Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming.

**Type.** Holotype male in collection of the University of Massachusetts. Type locality: Manchester, Vermont.

**Discussion.** *Boettcheria latisterna* has been noted both as a larval parasite (Breakey 1929; Bibby 1942) and as a pupal parasite (Knull 1932; Allen



1972). In both of these cases the maggots are reported to leave the hosts before pupating underground.

Knipling (1936) reared *B. latisterna* on decomposing hamburger and described the first instar larvae. Hallock (1929) reared this species on freshly killed grubs of *Popillia japonica* Newman (Coleoptera: Scarabaeidae) and described the first and third instars of the larvae. He found that females would not larviposit on the dead grubs in the cage, but the larvae developed rapidly on the grubs, after they were removed from gravid females by dissection. The larvae fed for a period of 4-5 days then began to wander away from the food. The larvae pupated one day after they began to wander, at the bottom of the soil in the cage. Adults emerged one month after pupariation.

Bibby (1942) reared one specimen from a dead last instar larva of *Heliothis zea* (Boddie) (= *H. armigera* (Hubner)) (Lepidoptera: Noctuidae). The *B. latisterna* larva wandered away from the putrid caterpillar and buried itself in sand at the bottom of the rearing container. The adult fly emerged 12 days later.

Sanjean (1957) reared this species on pork liver but could not find sufficient characters to separate the larvae of this species from *B. cimbicis*, which he fully described. His one group of rearings, at 27°C, produced the following means and ranges for the life stages: 1 (1) day for first instar; 1 (1) day for second instar; 8.8 (7-12) days for third instar; 10.6 (10-11) days for pupa; 21.4 (19-25) days for all stages. Nineteen larvae were removed from, or deposited by, one female. The puparium has been described by Greene (1925).

*Boettcheria latisterna* has been reported as a parasitoid of a variety of Lepidoptera. It has been reported as a parasitoid of the imported cabbage butterfly, *Pieris rapae* Linnaeus (Aldrich 1916; Chittenden 1926) (Lepidoptera: Pieridae) and a pierid chrysalis from Schenectady, New York (USNM); the iris borer, *Macronoctua onusta* Grote (Breakey 1929; 1931), the fall cankerworm, *Alsophila pometaria* (Harris) (Porter and Alden 1924; Sherman 1921; Thompson 1944), the corn earworm, *Heliothis zea* (Boddie) (= *H. obsoleta* (Fabricius) and *H. armigera* (Hubner)) (Phillips and King 1923; Bibby 1942), the darksided cutworm, *Euxoa messoria* (Harris) (Crumb 1929) (Lepidoptera: Noctuidae); and the elm spanworm, *Ennomos subsignarius* (Hubner) (Knull 1932; Anderson and Kaya 1976) (Lepidoptera: Geometridae). Hallock (1929) noted that live and just-killed larvae of *Anisota* sp. (Lepidoptera: Citheroniidae) were very attractive to gravid females of this fly, but no rearing record was obtained. One specimen from Gainesville, Florida

was reared from larvae of *Herse cingulata* (Fabricius) (Lepidoptera: Sphingidae) (USNM). Allen (1972) reported *B. latisterna* as a relatively uncommon pupal parasitoid of the saddled prominent, *Heterocampa guttivitta* (Walker) (Lepidoptera: Notodontidae).

Hallock (1929) was able to rear this species on dead grubs of the Japanese beetle *Popillia japonica* Newman (Coleoptera: Scarabaeidae). *Boettcheria latisterna* is reported as a parasitoid of May beetles, *Phyllophaga* sp. (= *Lachnosterna* sp.), *P. japonica* Newman (Coleoptera: Scarabaeidae); and the Mexican bean beetle, *Epilachna varivestis* Mulsant (Coleoptera: Coccinellidae), by Emden (1950).

One specimen was reared from *Melanoplus differentialis* (Thomas) (Orthoptera: Acrididae) in Lafayette, Indiana (USNM).

*Crabro advena* Smith (Hymenoptera: Sphecidae) has been reported to provision its nest with *B. latisterna* adults, along with a variety of other calyptrate flies (Evans *et al.* 1980; O'Brien and Kurczewski 1980).

*Boettcheria latisterna* has been reported by Payne and King (1972) as a scavenger species on pig carrion in open ground and water environments, as well as carrion elevated in a tree.

Judd (1956) collected 4 males and 5 females in traps baited with a malt extract in London, Ontario during 1953. Adults have been trapped and/or netted in Michigan onion fields (Merrill and Hutson 1953). Sanjean (1957) collected one gravid female, one nongravid female, and eight males during the latter part of 1951 and throughout 1952 in the Ithaca, New York area. Four specimens were collected at the following baits: human feces (2) and freshly killed American cockroaches (2). The remaining 6 specimens were collected at the following resting sites: stone wall (2), field stones (1), in grass (1), and in buildings (2). Specimens have been collected on parsnip and peony flowers and in CDC flytraps. Judd (1970) collected *B. latisterna* in a baited trap set out on the *Sphagnum* mat of Byron Bog in southwestern Ontario. This species has also been collected from thistle (UMinn) and on alfalfa (UMinn).

*Boettcheria latisterna* is typically found in wooded areas, with or without associated undergrowth. The males often take stations on green leaves or logs in the morning in direct sunlight. This species is usually collected from ground level up to 1 m (personal observations).

Normally, this species has black colored legs but some specimens have bright orange legs. Specimens

from the southeastern United States, especially Florida, often show the orange leg variation, and often the sharp color contrast of the darkly colored body of the fly and the bright orange legs is visually very striking. Parker (1914), in his original description, noted this variation and it is mentioned by Lopes (1975). Reinhard (1952) described the orange leg variety as a distinct subspecies, *B. latisterna irrisoris*, but did not mention any locality data of types in his description. Byers *et al.* (1962) listed three male and one female paratypes of Reinhard's subspecies in the collection of the Snow Entomological Museum. This variation, however, does not deserve subspecies status since it occupies no distinct geographical area. It is more common in the southern range of the species, but occasional specimens with orange legs have been seen from as far north as Ottawa, Ontario.

***Boettcheria litorosa* (Reinhard)**

(Figures 3-4, 39-48, Map 2)

*Sarcophaga litorosa* Reinhard 1947: 115-116, figure 19; type locality: Sequoia National Park, California; male holotype (description). Ryckman 1953: 146 (biology). Byers *et al.* 1962: 162 (location of types). Cole and Schlinger 1969: 502 (locality records).

*Boettcheria litorosa*; Lopes 1950: 699, 723, figure 51 (redescription). Davis and Turner 1978: 121, table 1, 4-7, 13 (biology). Pape 1989: 433 (included in redefined genus).

*Boettcheria carata* Roback 1952: 48, figure 4a-d; type locality: Monterey Co., California; male holotype (description). Roback 1954: 12, 82, chart 8, figures 344-345 (male genitalia).

**Description. Male.** Total length 9-13 mm. Fifth sternum with posterior lobes thin; with small, lightly sclerotized, posterodorsal projections on each side of the apical midline (Fig. 42). Aedeagus with vesica trilobed, the outer membranous lobes thinner and longer than central sclerotized lobe; central lobe of vesica curled inward at the lateral margins, in anterior view (Fig. 40); flattened, wing-like lateral processes present on the juxta. Basal segment of paramere much smaller than apical segment. Apical segment of paramere resembles the larger portion of a crayfish's cheliped; with one large seta (Fig. 41). Surstylus abruptly narrowing near midpoint (Fig. 43). Cerci with protuberant basal lobes (Fig. 44).

**Female.** Total length 8-11 mm. Posterior surface of mesofemur with a medial area bare of pruinosity, often reddish in color. Sterna 6 and 7 subequal in size. Sternum 8 smaller and bluntly

heart shaped (Fig. 48). Sternum 9 lightly sclerotized. Sternum 10 unsclerotized, with scattered medium and long, thin setae (Fig. 47). Cercus with long apical setae; noticeably larger in size when compared to cerci of other Nearctic *Boettcheria*. Spermathecae darkly sclerotized and trilobed, although the apical lobe is not marked by as clear of a constriction as the basal lobe (Fig. 46). Accessory glands membranous (Fig. 45).

**Diagnosis.** Males that have not had their genitalia spread can usually be separated from *B. cimbicis* by the lack of posteromesal lobes on the fifth sternite and from *B. latisterna* by the setae on the anterior face of the mesofemur. The flattened, wing-like processes of the juxta are very distinctive when the aedeagus is observed in posterior view, and easily separates spread male specimens from other species. Species level determination of female specimens will generally require dissection, as no nongenitalic features have been identified which will readily separate this species from the sympatric *B. latisterna*. The shape of the ninth sternum separates it from *B. latisterna* and *B. mexicana*.

**Distribution.** Canada: Alberta, British Columbia, Northwest Territories, Yukon Territory; U.S.A.: Arizona, California, Colorado, Idaho, Montana, Oregon, South Dakota, Washington, Wyoming.

**Type.** Holotype male in the Snow Entomological Museum (University of Kansas). Type locality: Sequoia National Park, California.

**Discussion.** This is the most commonly collected western species of *Boettcheria*. Davis and Turner (1978) reared one specimen of this species on liver. They indicated that the larva took 6 days to develop from first instar larva to pupa and the adult female emerged 4 days later. This species has also been reared on milk soaked paper by J. E. Dimit (WSU).

Ryckman (1953) records *B. litorosa* as a parasitoid of the bumblebee, *Bombus sonorus* Say (Hymenoptera: Apidae). It has also been reared from *Melanoplus* sp. (Orthoptera: Acrididae) in Oregon (USNM).

Davis and Turner (1978) collected *B. litorosa* from June to September in Wallowa-Whitman National Forest in northeastern Oregon. They collected *B. litorosa* from seven of their ten study plots within the forest. In their discussion of physical plot differences, no information was given to explain why they were not found in all 10 study areas. They collected this species in an unbaited Malaise trap, but not in liver baited Malaise traps, nor Malaise traps baited

with several types of excreta. However, A.J. Basinger collected this species at fish bait and fresh chicken guts (CAS).

We have seen many specimens collected at elevations greater than 4000 feet, the highest elevation noted on a specimen label was 10,240 feet at Tennessee Pass in Colorado (USNM).

### ***Boettcheria melanderi* Dodge**

(Figures 49-54, Map 1)

*Boettcheria melanderi* Dodge 1967: 682, figure 1A; type locality: Quilcene, Washington; male holotype (description).

*Boettcheria pugetensis* Dodge 1967: 682-683, figure 1B; type locality: Bellingham, Washington; male holotype (description). NEW SYNONYMY.

**Description. Male.** Total length 14-18 mm. Fifth sternum of comparable size to other *Boettcheria* species, with 2 anteriorly projecting apical flaps and posterolateral lobes not elongated, giving the entire sternum much more of a square appearance than seen in other Nearctic *Boettcheria* (Fig. 51). Aedeagus very large; vesica directed posteriorly in lateral view (Fig. 49); outer membranous lobes of vesica subequal in size to middle sclerotized lobe and central lobe of vesica with a distinct basal, darkly sclerotized "M" marking in anterior view (Fig. 50). Gonopod large, narrowing smoothly to an apical point. Basal segment of paramere much smaller than apical segment. Apical segment of paramere resembles the larger portion of a crayfish's cheliped; with one large seta (Fig. 52). Surstylus lightly sclerotized and bluntly rounded at apex (Fig. 53). Cerci large and elongate, separated approximately 1/3 of total length (Fig. 54).

**Female.** Unknown.

**Diagnosis.** This species' range is sympatric with that of *B. latisterna* and *B. litorosa*, but it appears to be very uncommonly collected. The anterior face of the metafemur does not have the setae concentrated near the apex, which will separate unspread specimens from *B. latisterna*. No striking external features have been found to separate unspread specimens of *B. melanderi* from *B. litorosa*. However, all specimens of *B. melanderi* examined by the authors were very large, so that only unspread specimens of large size should need to be dissected to separate these two species.

The distinctive and large genitalia of this species easily separates it from all others. It is similar

to the allopatric *B. bisetosa* in the shape of fifth sternum, aedeagus, and surstylus, but it has 3 katepisternal setae and possesses presutural acrostichal setae.

**Distribution.** Canada: British Columbia; U.S.A.: Oregon, Washington. The eleven specimens examined were from: Quilcene and Bellingham, WA (USNM); Terrace and 6 mi. W. Terrace on Gagnon Rd, B.C. (CNC); Mt. Ranier, WA; Portland, OR; 10 mi. E. Brookings, Bear Wallo L. D., OR; Portland, OR; Hood River, OR (OrSU, GAD); Earwig Parasite Laboratory, Portland, OR (GAD).

**Type.** Holotype male in the United States National Museum of Natural History. Type locality: Quilcene, Washington.

**Discussion.** *Boettcheria pugetensis* was originally separated from *B. melanderi* on the basis of the greatly reduced vesica of the former. Upon examination of the holotype of *B. pugetensis*, the vesica was found to be broken off and stuck on the inside of the genital capsule. It conforms to *B. melanderi* in all respects and is here synonymized with it.

Specimens have been collected from June 24 to August 11. No other biological information concerning this species is presently available.

### ***Boettcheria mexicana* Lopes**

(Figures 55-64, Map 4)

*Boettcheria mexicana* Lopes 1950: 702-703, 727-728, figures 67-71; type locality: Bosencheve National Park, Mexico, MEXICO; male holotype (description). Pape 1989: 433 (included in redefined genus).

**Description. Male.** Total length 9-11 mm. Fifth sternum with posterior divergent and bluntly rounded; with small, lightly sclerotized, posterodorsal projections on each side of the apical midline (Fig. 58). Aedeagus with vesica trilobed, in anterior view, with the middle lobe sclerotized and as wide or wider than the membranous outer lobes (Fig. 56); inner margin of juxta convoluted, in lateral view (Fig. 55). Gonopod smoothly tapering to apical point, with small anterior hump near middle (Fig. 57). Basal segment of paramere much smaller than apical segment. Apical segment of paramere resembles the larger portion of a crayfish's cheliped, with one large seta (Fig. 57). Surstylus blunt apically with a bit of a point anteriorly (Fig. 59). Cerci bulging mesally and with inner margin, after separation, nearly parallel until just before tip, where the apices diverge (Fig. 60).

**Female.** Total length 8-9 mm. Sterna 6 and 7 subequal in size. Sternum 8 longer than preceding 2 segments and with 2 distinct basal lobes (Fig. 64). Sternum 9 lightly sclerotized and irregular in shape. Sternum 10 unsclerotized, with scattered long, thin setae at apex (Fig. 63). Cerci with long apical setae. Spermathecae darkly sclerotized and trilobed, with basal lobe smaller than apical lobe and spermathecal tubes abruptly narrow in apical 1/3 of length (Fig. 62). Accessory glands membranous (Fig. 61).

**Diagnosis.** Unspread males can usually be separated from other sympatric *Boettcheria* species north of Mexico. The grey tergum 5 separates this species from *B. praevolans* and the absence of posteromesal lobes on the fifth sternite will separate this species from *B. cimbicis*. Females of this species can be separated from *B. praevolans* by the grey tergum 5 and from *B. cimbicis* by the presence of a medial area bare of pruinosity on the posterior face of the metafemur. The genitalia easily separates this species from all others if dissections are performed.

**Distribution.** U.S.A.: Arizona. Specimens examined from localities north of the U.S.A.-Mexico border include: Rustler's Park Cove, Creek Can., Chiricahua Mts., AZ (USNM); (5) Barfoot Lookout, Chiricahua Mts., AZ and Eldon Mt., Flagstaff, AZ (WLD). Additional specimens from Mexican localities were also examined.

**Type.** Holotype male in the collection of the Instituto Oswaldo Cruz, Brazil. Type locality: Bosencheve National Park, Mexico, MEXICO.

**Discussion.** Males of this species have been collected on the roof of a firetower on the top of Eldon Mt. near Flagstaff, Arizona and near a lookout house on the top of one of the Chiricahua Mountains in Arizona by W. L. Downes.

### *Boettcheria praevolans* (Wulp)

(Figures 65-73, Map 4)

*Sarcophaga praevolans* Wulp 1896: 275, plate VII, figure 8; type localities: Xucumanatlan, Guerrero, MEXICO and Orizaba, MEXICO; two males and one female syntypes (description). Aldrich 1930: 31-32, figures 9a-b (redescription). Cole and Schlinger 1969: 503 (locality records).

*Boettcheria praevolans*; Lopes 1946: 123-125, figures 7-11 (redescription). Lopes 1950: 703-705, 728-729, figures 72-79 (redescription). Pape 1989: 433 (included in redefined genus).

*Sarcophaga sicca* Reinhard 1947: 117, figure 20; type locality: Sunnyside Canyon, Huachuca Mts., Arizo-

na; male holotype (description). Byers *et al.* 1962: 161 (location of types).

**Description. Male.** Total length 7-12 mm. Tergum 5 orange. Fifth sternum with posterior lobes distinctly widened basally; with small, posterodorsal, unsclerotized lobes on each side of the apical midline (Fig. 68). Aedeagus, in lateral view, with 3 sharp projections extending anteriorly from near the base of the vesica (Fig. 65); trilobed vesica with outer membranous lobes thinner and just a little longer than central sclerotized lobe, in anterior view; central lobe of vesica flat medially, with sharp apical lateral processes (Fig. 66). Gonopod with an anteromedial hump and tuberculate apical point (Fig. 67). Basal segment of paramere much smaller than apical segment. Apical segment of paramere not widening abruptly basally; with one large seta (Fig. 67). Surstylus thick, tapering to an apical point (Fig. 69). Apices of cerci widely separated (Fig. 70).

**Female.** Tergum 5 orange, with strong setae on the posterior margin. Sterna 6 and 7 much broader than the preceding abdominal sterna. Sternum 8 broad and posteriorly rounded; with anterolateral margins distinctly curved and projecting (Fig. 73). Sternum 9 lightly sclerotized with diverging posterior lobes. Sternum 10 membranous and with very few setae (Fig. 72). Cercus with several strong apical setae. The chamber into which the ducts of the accessory glands and the spermathecae empty is highly modified and appears as a lightly sclerotized three-lobed structure just anterior to the ninth sternum (Fig. 71). In all other species of *Boettcheria* examined, the chamber is transparent and unsclerotized except for three very small spots. Spermathecae are darkly sclerotized and trilobed, the apical lobe smaller than the basal lobe with the spermathecal tubes abruptly narrowing apically (Fig. 71).

**Diagnosis.** The orange tergum 5 will easily separate unspread males and undissected females of this species from all other sympatric species of *Boettcheria*.

**Distribution.** U.S.A.: Arizona. Specimens examined from localities north of the U.S.A.-Mexico border include: Ransey Cyn., 15 mi. S. Sierra Vista, Huachuca Mts., AZ (CNC); Sunnyside Canyon, Huachuca Mts., AZ (SEM). Additional specimens from Mexican and Central American localities were also examined.

**Type.** Two males and 1 female syntypes in collection of the British Museum of Natural Histo-

ry. Type localities: Xucumanatlan, Guerrero, MEXICO and Orizaba, Cuernavaca, MEXICO.

**Discussion.** *Boettcheria praevolans* has been collected within 0.5 m of the ground in urban areas near San José, Costa Rica. No other biological information is currently available concerning this species.

### Acknowledgements

The following institutions and individuals have lent material for this study, the assistance of the curators responsible is gratefully acknowledged: California Academy of Sciences (CAS), P.H. Arnaud, Jr.; Canadian National Collection (CNC), G.E. Shewell; Dayton Museum of Natural History (DMNH), G.A. Coovert; personal collection of G.A. Dahlem (GAD); personal collection of W.L. Downes, Jr. (WLD); Florida State Collection of Arthropods (FSCA), H. V. Weems, Jr.; Michigan State University (MSU), R.L. Fischer; Museum of Comparative Zoology at Harvard University (MCZ), K. Jepson; The Ohio State University (OSU), C.A. Triplehorn; Oregon State University (OrSU), K.A. Phillips; Snow Entomological Museum at The University of Kansas, G.W. Byers; United States National Museum of Natural History (USNM), R.J. Gagne; University of California at Davis (UCDav), R.O. Schuster; University of Minnesota (UMinn), P.J. Clausen; University of New Hampshire (UNH), D.S. Chandler; Washington State University (WSU), R.S. Zack.

This manuscript grew from G.A. Dahlem's thesis on the *Boettcheria*, completed in partial fulfillment of the requirements for a Master of Science degree at The Ohio State University under N. Johnson. N. Johnson's generous and skillful guidance is gratefully acknowledged.

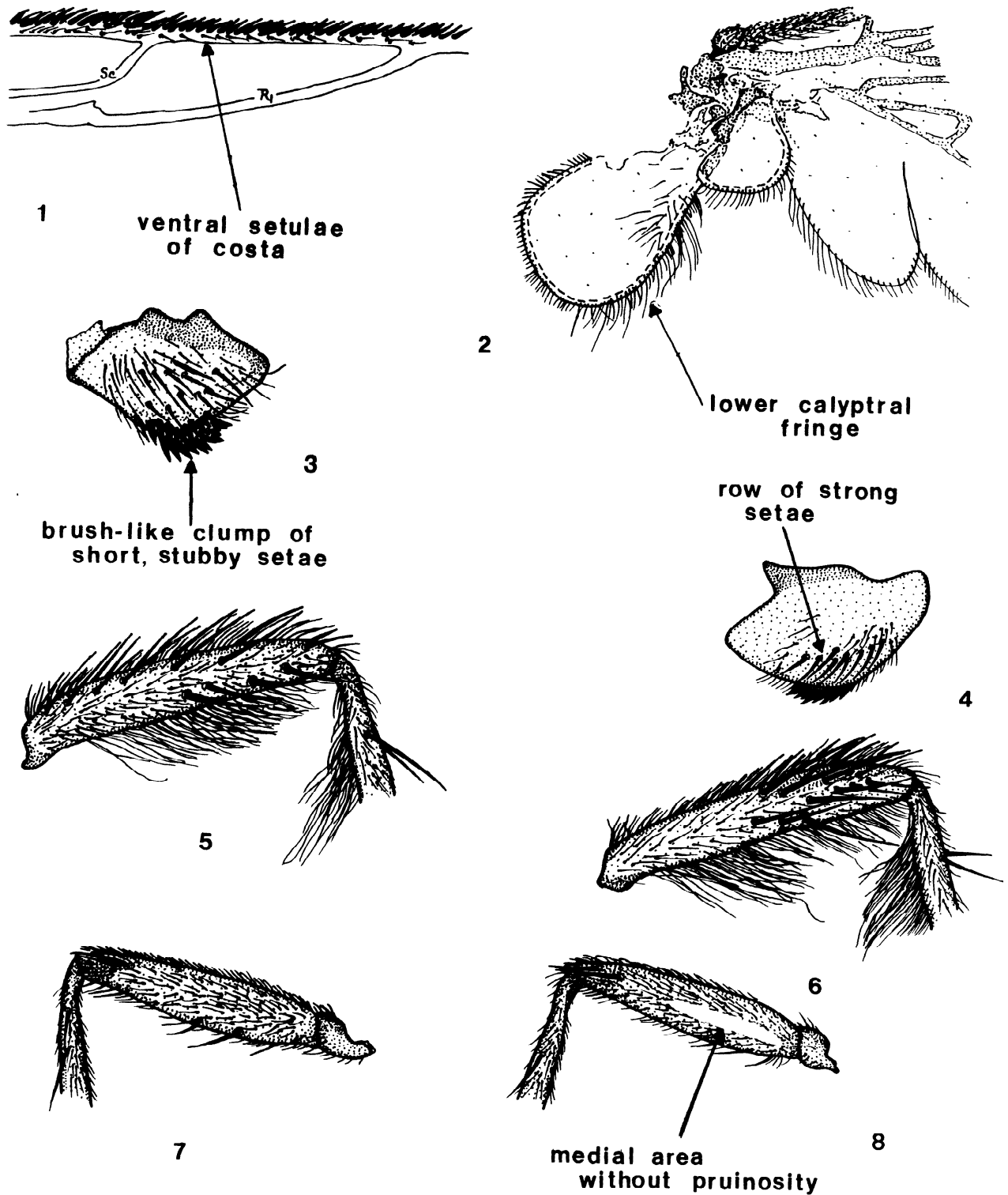
We also wish to thank Rob Naczi at Northern Kentucky University and Thomas Pape at the Swedish Museum of Natural History for their very helpful reviews of this manuscript.

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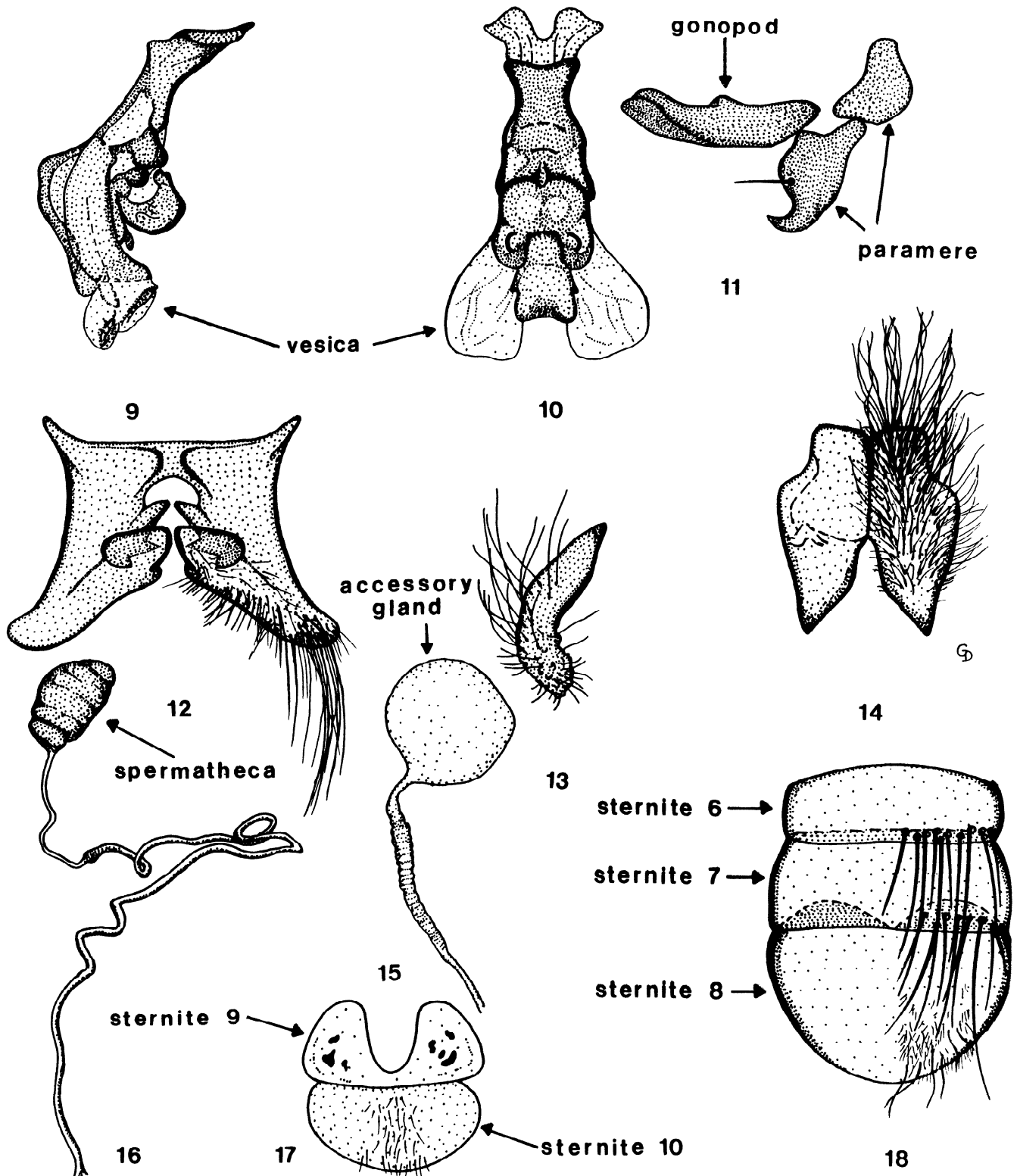
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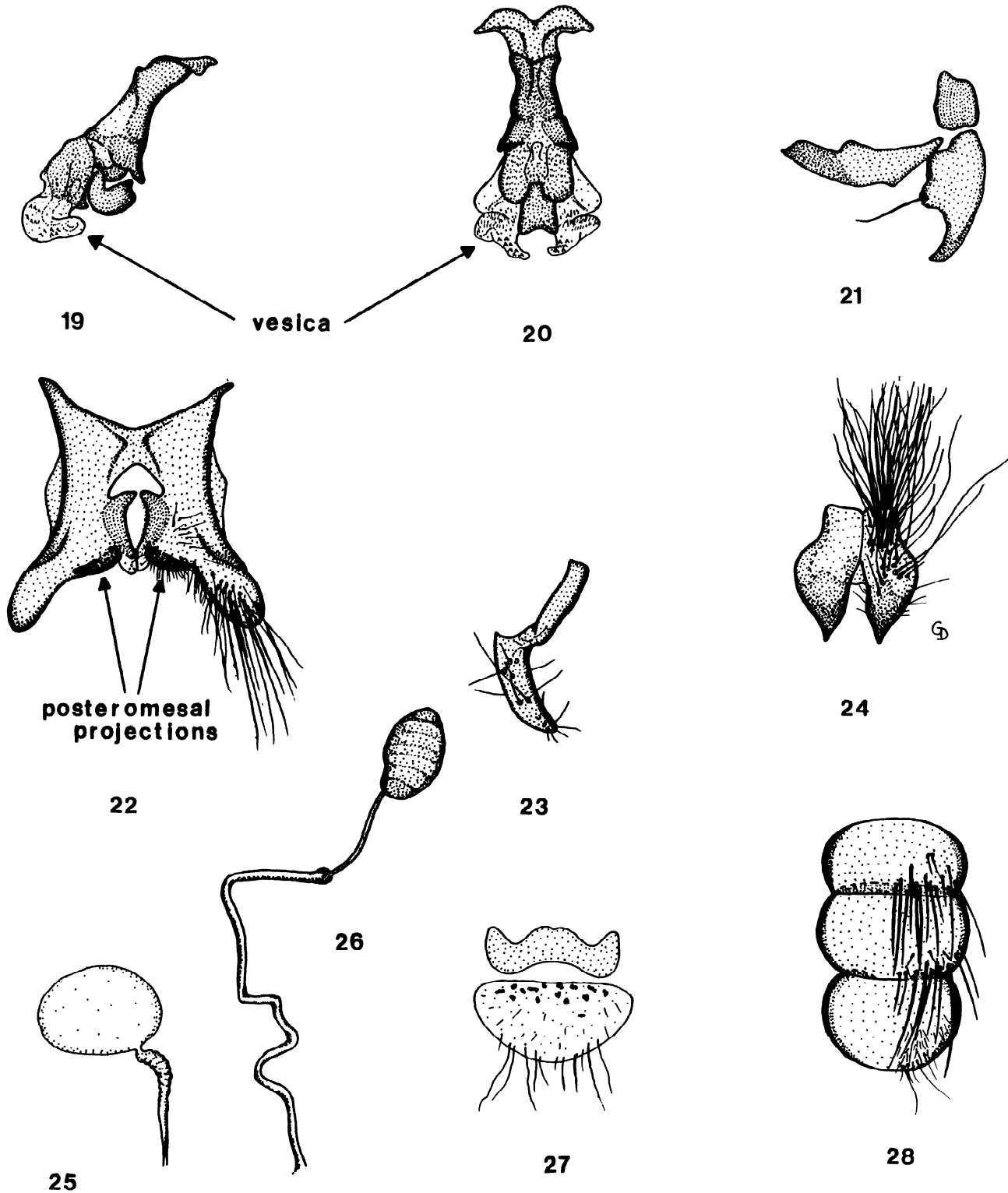


Figures 1-8. 1, detail of ventral surface of wing of *Boettcheria cimbicis*; 2, detail of ventral surface of wing base with upper and lower calypteres of *B. cimbicis*; 3, anterior view of metatrochanter of male *B. litorosa*; 4, posterior view of metatrochanter of male *B. litorosa*; 5, anterior surface of metafemur of male *B. cimbicis*; 6, anterior surface of metafemur of male *B. latisterna*; 7, posterior surface of mesofemur of female *B. cimbicis*; 8, posterior surface of mesofemur of female *B. latisterna*.

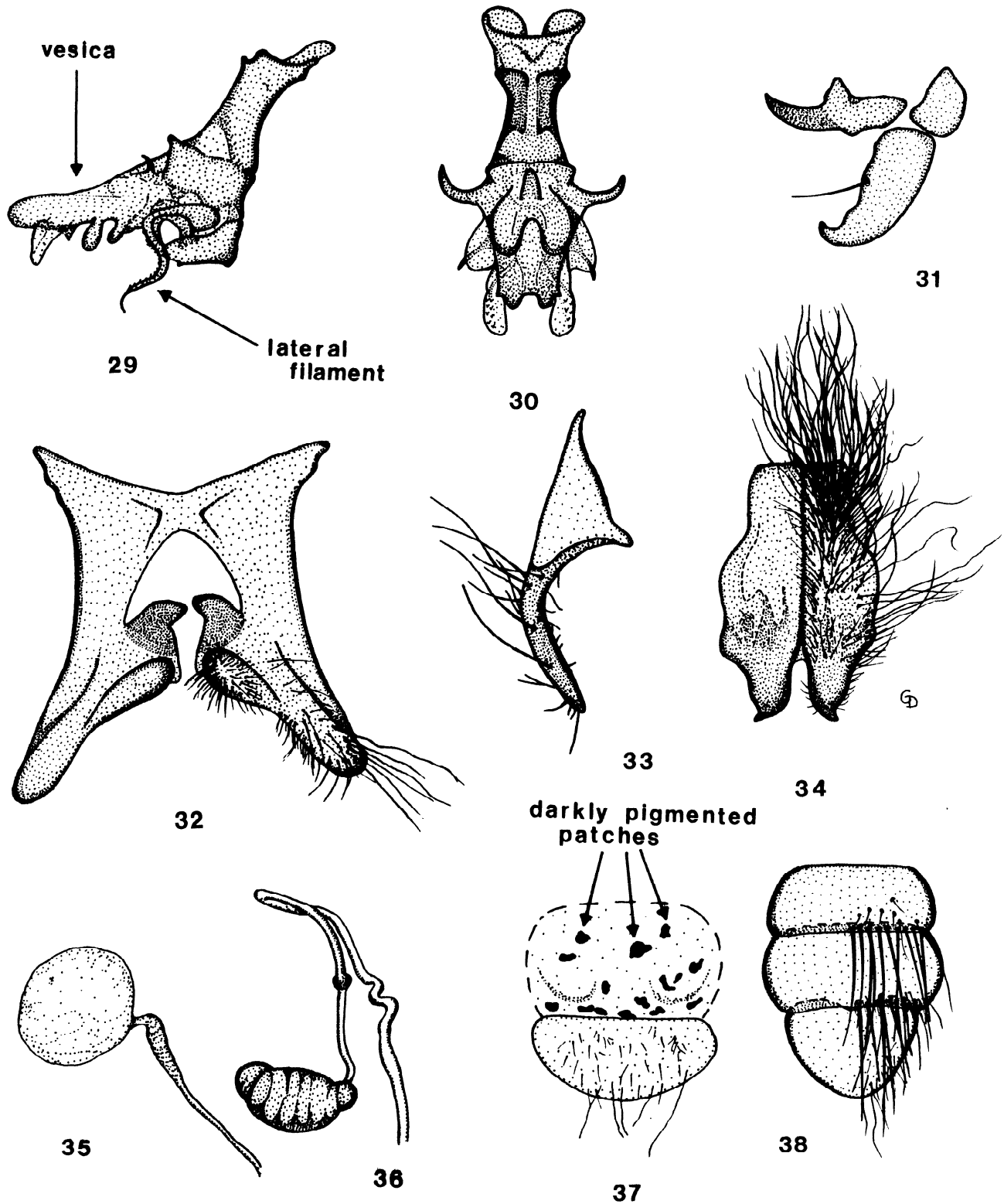




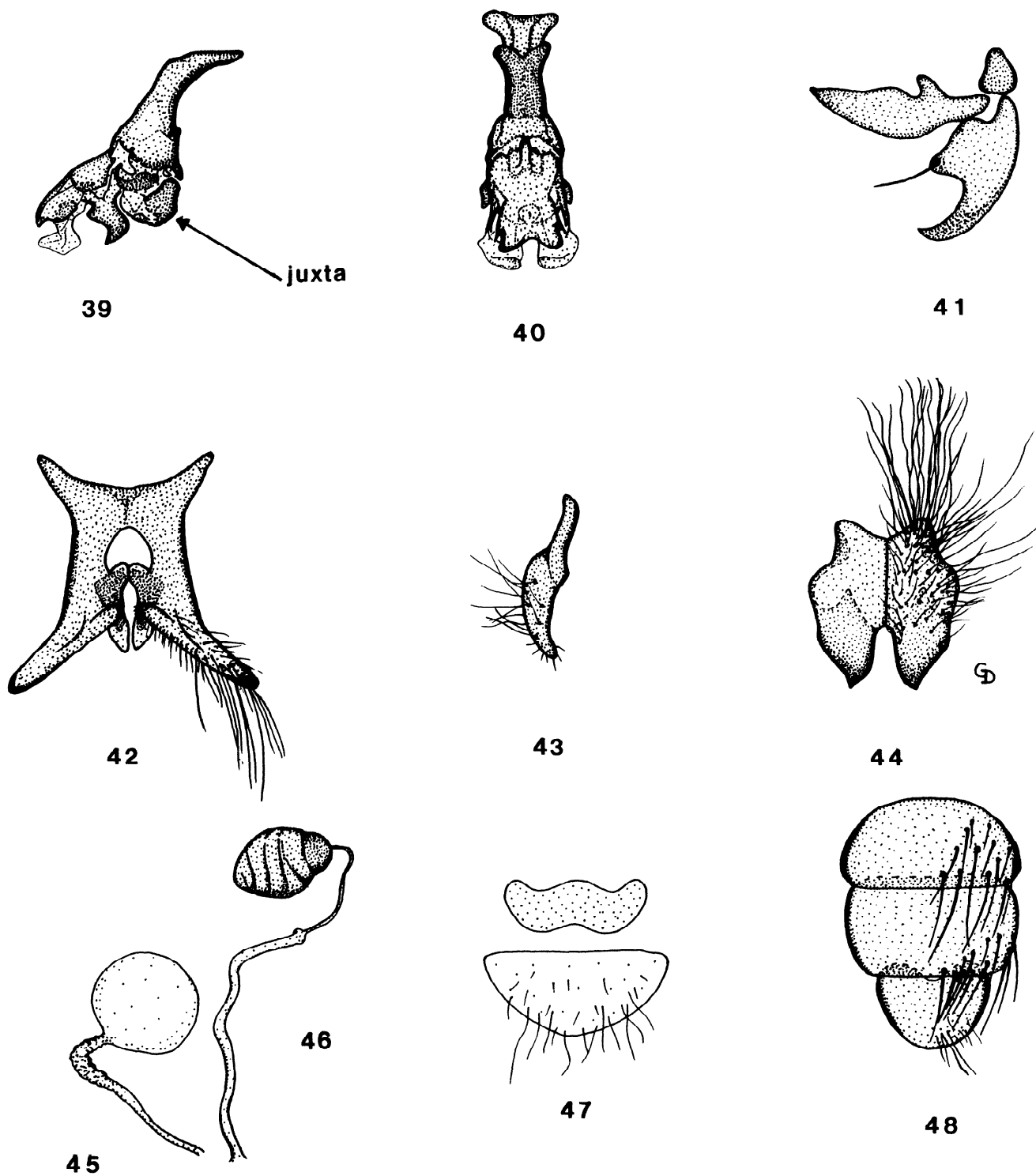
Figures 9-18. *Boettcheria bisetosa*; 9-14, male; 15-18, female; 9, lateral view of aedeagus; 10, anterior view of aedeagus; 11, gonopod and paramere; 12, fifth sternite; 13, surstylus; 14, cerci; 15, accessory gland; 16, spermatheca; 17, ninth and tenth sternite; 18, sixth, seventh and eighth sternite.



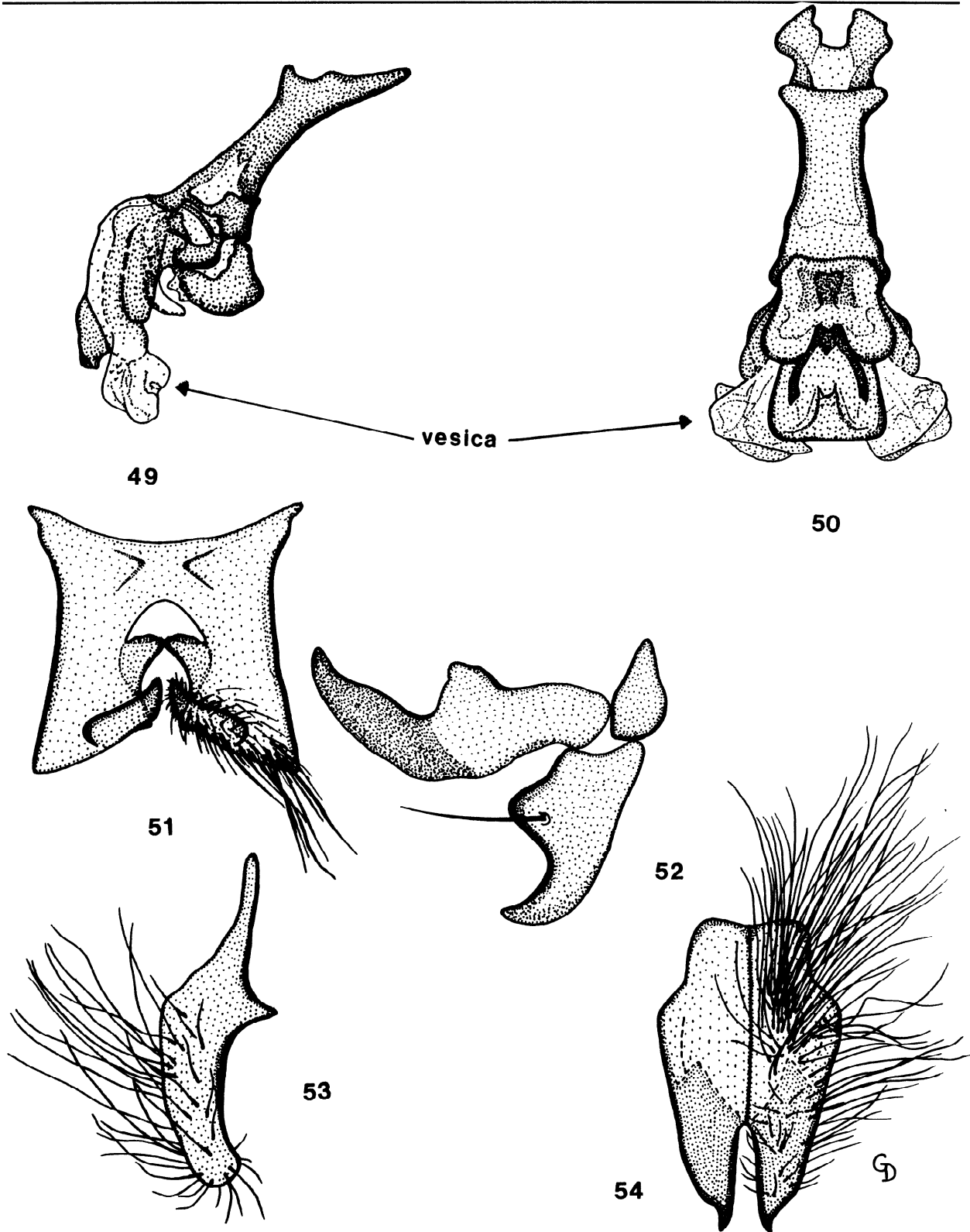
Figures 19-28. *Boettcheria cimbicis*; 19-24, male; 25-28, female; 19, lateral view of aedeagus; 20, anterior view of aedeagus; 21, gonopod and paramere; 22, fifth sternite; 23, surstylus; 24, cerci; 25, accessory gland; 26, spermatheca; 27, ninth and tenth sternite; 28, sixth, seventh and eighth sternite.



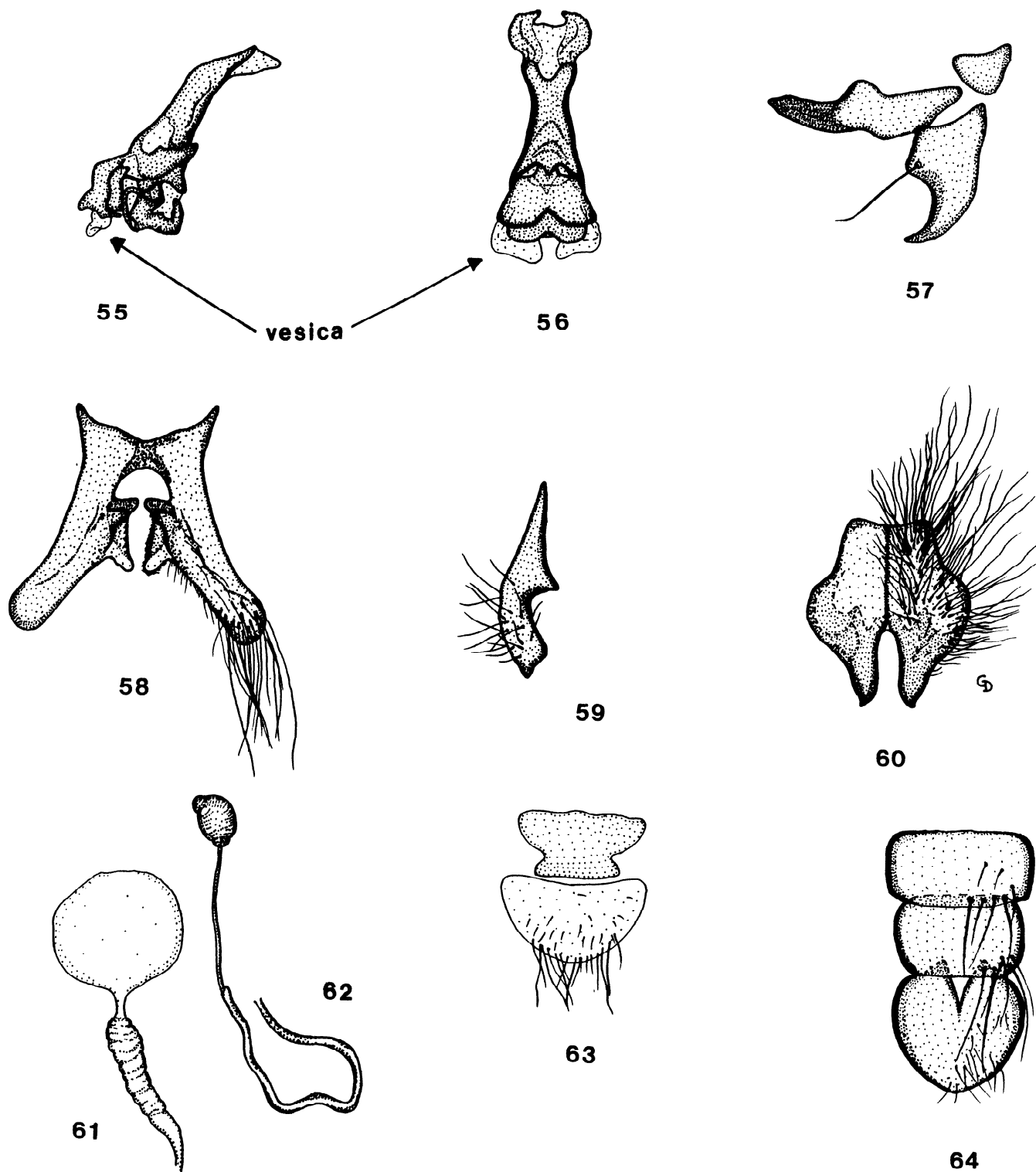
Figures 29-38. *Boettcheria latisterna*; 29-34, male; 35-38, female; 29, lateral view of aedeagus; 30, anterior view of aedeagus; 31, gonopod and paramere; 32, fifth sternite; 33, surstylus; 34, cerci; 35, accessory gland; 36, spermatheca; 37, ninth and tenth sterna; 38, sixth, seventh and eighth sterna.



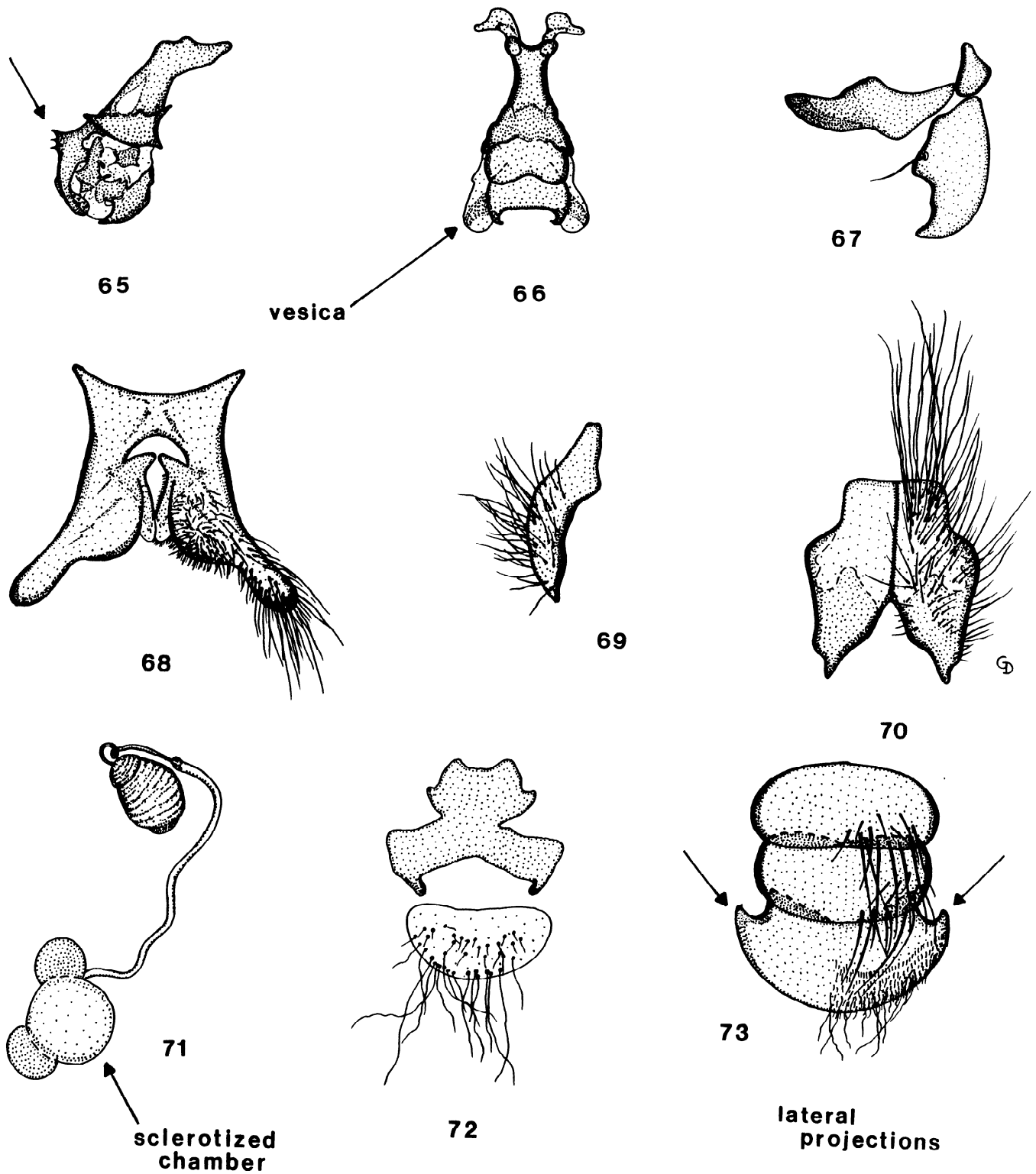
Figures 39-48. *Boettcheria litorosa*; 39-44, male; 45-48, female; 39, lateral view of aedeagus; 40, anterior view of aedeagus; 41, gonopod and paramere; 42, fifth sternite; 43, surstylus; 44, cerci; 45, accessory gland; 46, spermatheca; 47, ninth and tenth sterna; 48, sixth, seventh and eighth sterna.



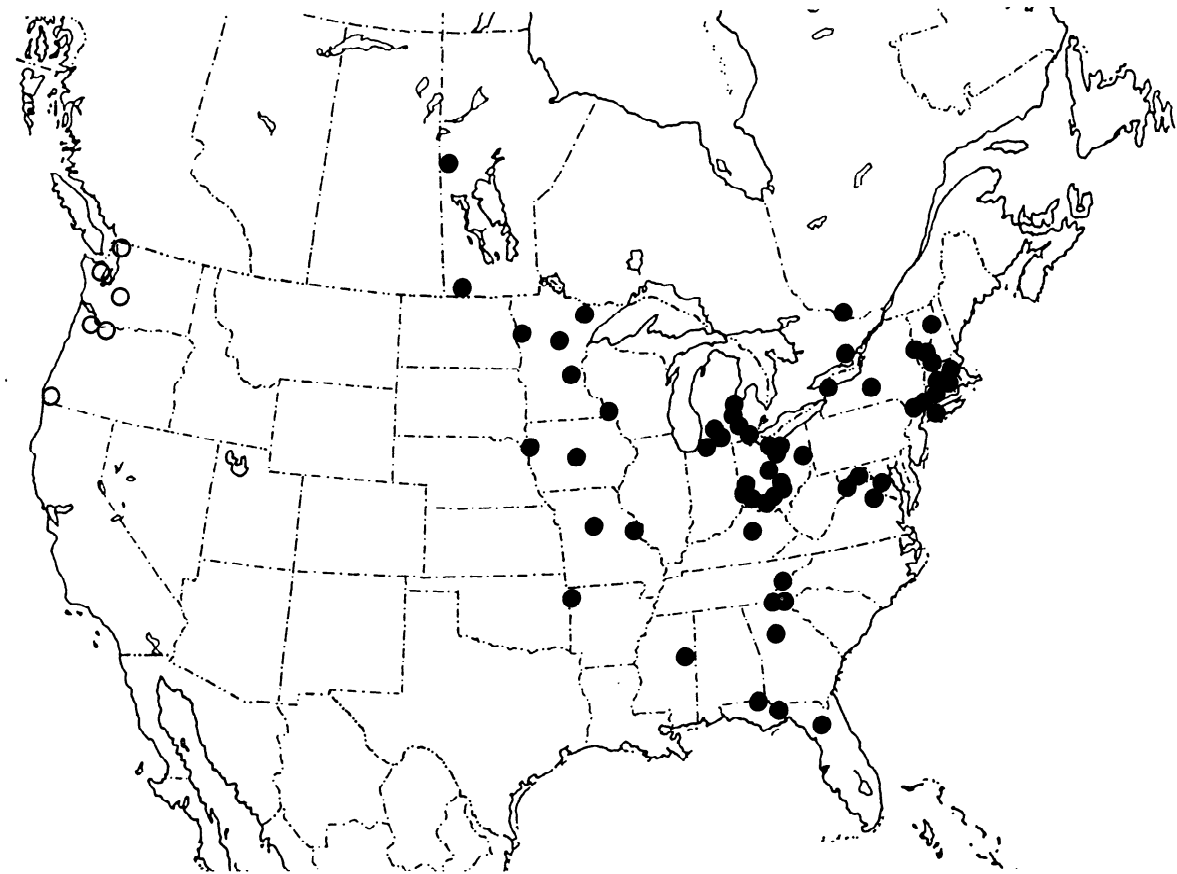
Figures 49-54. *Boettcheria melanderi*, male; 49, lateral view of aedeagus; 50, anterior view of aedeagus; 51, fifth sternite; 52, gonopod and paramere; 53, surstylus; 54, cerci.



Figures 55-64. *Boettcheria mexicana*; 55-60, male; 61-64, female; 55, lateral view of aedeagus; 56, anterior view of aedeagus; 57, gonopod and paramere; 58, fifth sternite; 59, surstylus; 60, cerci; 61, accessory gland; 62, spermatheca; 63, ninth and tenth sterna; 64, sixth, seventh and eighth sterna.

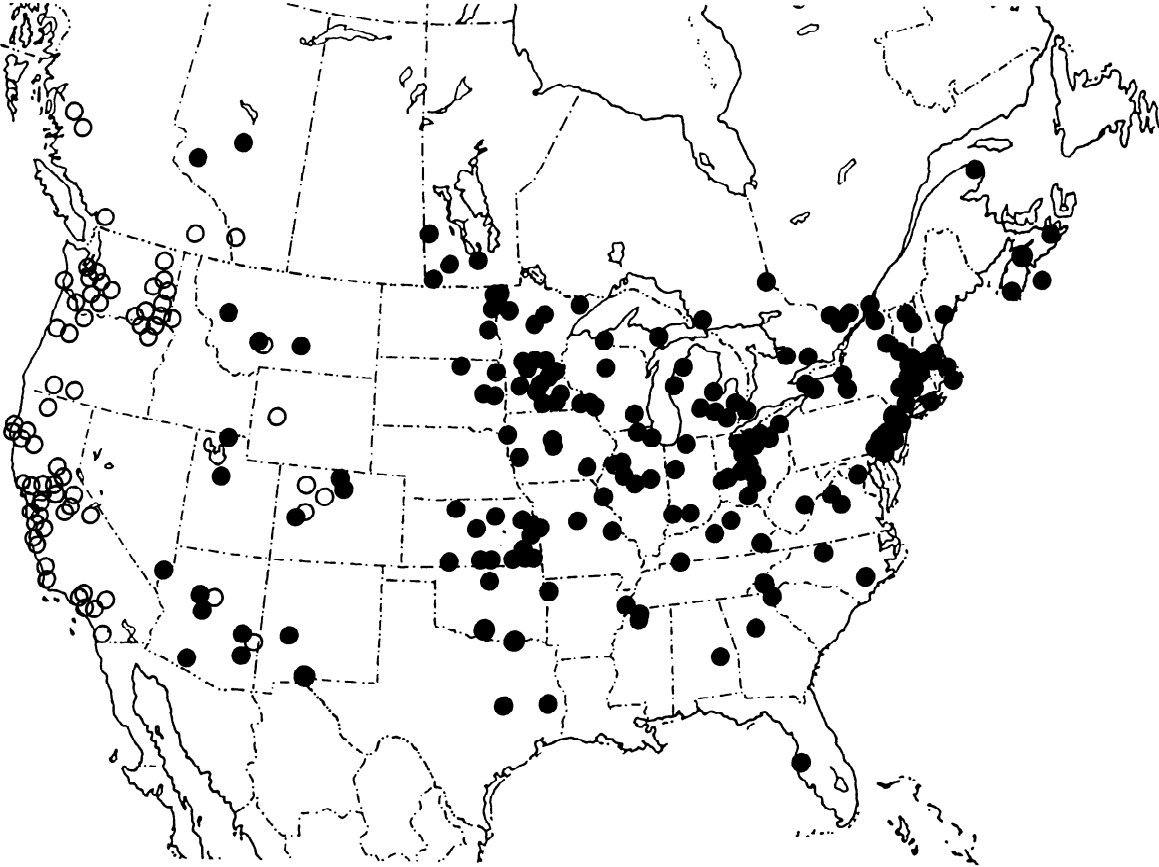


Figures 65-73. *Boettcheria praevolans*; 65-70, male; 71-73, female; 65, lateral view of aedeagus; 66, anterior view of aedeagus; 67, gonopod and paramere; 68, fifth sternite; 69, surstylus; 70, cerci; 71, spermatheca; 72, ninth and tenth sterna; 73, sixth, seventh and eighth sterna.

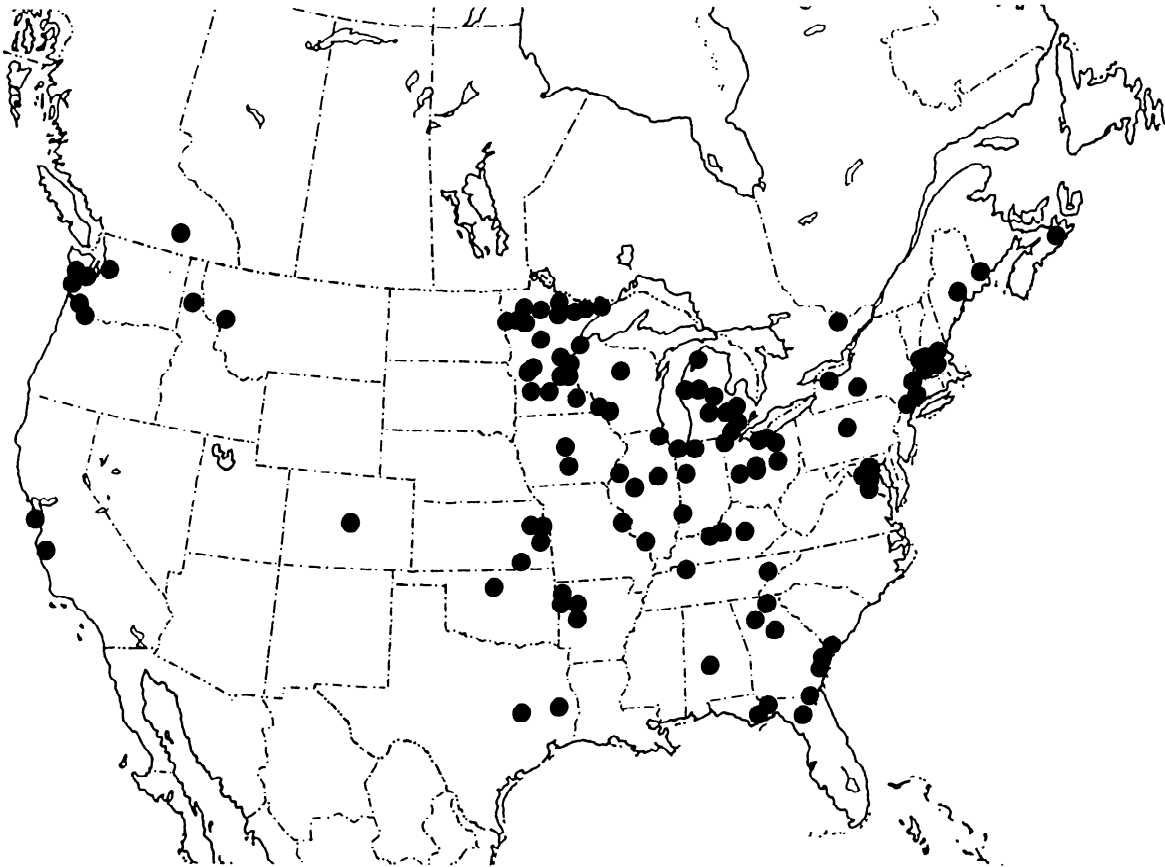


Map 1. Distribution of *Boettcheria bisetosa* (solid circles) and *B. melanderi* (open circles).

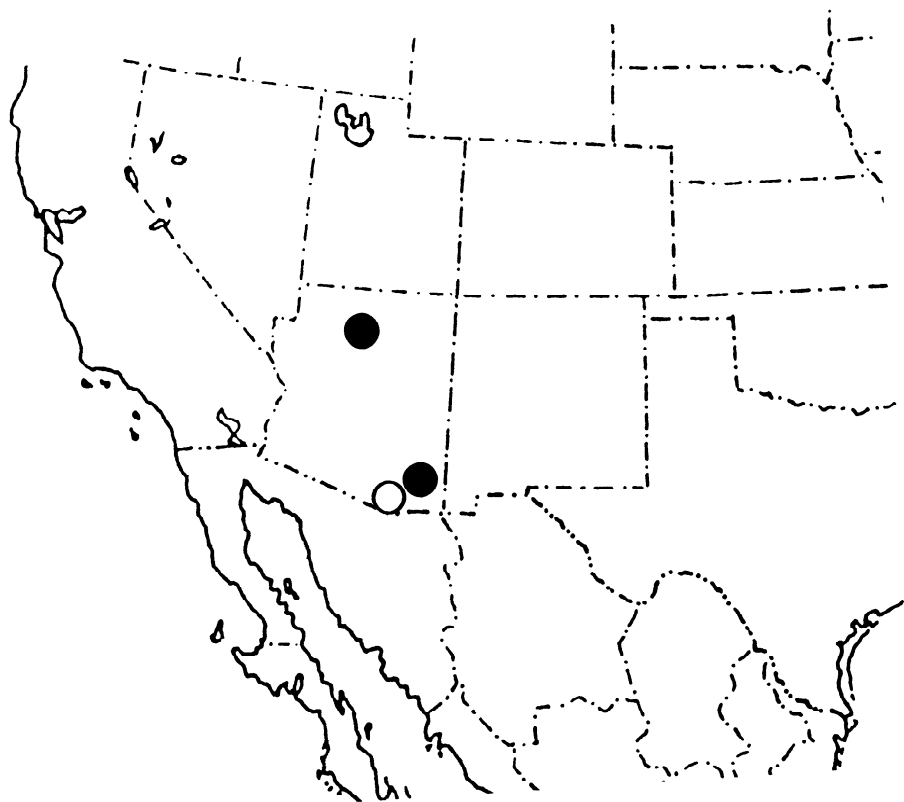




Map 2. Distribution of *Boettcheria cimbicis* (solid circles) and *B. litorosa* (open circles).



Map 3. Distribution of *Boettcheria latisterna* (solid circles).



Map 4. Distribution of *Boettcheria mexicana* (solid circles) and *B. praevolans* (open circles).