



Nine new species of Agromyzidae from North Carolina, USA, with new host and distribution records for additional species

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Abstract

We present novel rearing records of Agromyzidae (Diptera) from three years of collecting in North Carolina, USA. These include the first reported host for *Calycomyza novascotiensis* Spencer (new to the USA) and new host records for *Ophiomyia beckeri* (Hendel) (new to North America), *Liriomyza helianthi* Spencer, *L. schmidtii* (Aldrich), and *Phytomyza plantaginis* Robineau-Desvoidy, all of which are reported from North Carolina for the first time. We review host and distribution data for each of these species and describe their leaf mines. We describe the following nine new species: *Agromyza arundinariae*, *A. indistincta*, *Calycomyza chrysopsidis*, *Cerodontha (Butomyza) enigma*, *Cer. (Poemyza) arundinariella*, *Cer. (P.) saintandrewsensis*, *Liriomyza carphophori*, *L. polygalivora*, and *L. triodanidis*. Seven host plant genera are new for world Agromyzidae: *Carphephorus* Cass., *Chrysogonum* L., *Chrysopsis* (Nutt.) Elliott, *Krigia* Schreb., *Pyr-rhopappus* DC. (Asteraceae), *Triodanis* Raf. ex Greene (Campanulaceae), and *Arundinaria* Michx. s.s. (Poaceae). Host plants of the new species also include *Bidens* L., *Mikania* Willd. (Asteraceae), *Dichantherium* (Hitc. & Chase) Gould (Poaceae), and *Polygala* L. (Polygalaceae).

Key words: bamboo, epidermal mining, gregarious larvae, leafminer, plant-insect interactions, rearing

Introduction

Agromyzidae is a family of flies with 835 described species in America north of Mexico (Eiseman 2018; Scheffer & Lonsdale 2018; Eiseman & Lonsdale 2018). Larvae are phytophagous and many species are leafminers, but others mine or bore in herbaceous stems, bore in the youngest xylem of woody plants, feed in flowers or seeds, or induce twig galls. Of the 615 species known from the lower 48 states of the USA, host plants are known for just 326 (53%) (Eiseman & Lonsdale 2018).

Since 2011, CSE has been compiling data on all North American leaf-mining insects (Agromyzidae as well as other Diptera, Lepidoptera, Coleoptera, and Hymenoptera) and constructing dichotomous keys to the known mines occurring on each host plant genus (Eiseman 2018). In August 2014, TSF initiated a biodiversity inventory at St. Andrews University in Laurinburg, North Carolina (Scotland County), involving multiple taxonomic groups (plants, vertebrates, mollusks, spiders, and several insect groups). As part of this inventory, he began collecting records of leaf-mining insects, and in 2015 he began rearing them whenever possible in collaboration with CSE. After finding several leafminers that appeared to represent undescribed species, TSF began searching for leafminers in other locations, mostly in Durham County, North Carolina. The Piedmont Wildlife Center, in particular, has run several bioblitz events, and TSF has contributed to their species inventory, as well as to North Carolina state inventories. Here we present new host and distribution records, as well as new species descriptions, resulting from the first three years of these efforts—beyond the numerous records already reported by Eiseman & Lonsdale (2018).

Materials and methods

TSF collected leaf mines at several locations in the Sandhills and Piedmont regions of North Carolina between 2015 and 2017. At Aberdeen Lake Park (35.136930 N, -79.431231 W) is a mix of pine/hardwood forest and swampland along a lake shore, from which *Arundinaria tecta* (Walter) Muhl. (Poaceae) leaves were collected. Leaves were collected from several locations and habitats at St. Andrews University, including *Arundinaria tecta* from a swamp edge (approximate location 34.737861 N, -79.473159 W), *Carphephorus bellidifolius* (Michx.) Torr. & A. Gray (Asteraceae) in a remnant overgrown sandhill (approximate location 34.740014 N, -79.474471 W), *Gelsemium sempervirens* (L.) W.T. Aiton (Gelsemiaceae) at a mixed pine-hardwood forest edge (34.739627 N, -79.479598 W), *Hypochaeris chillensis* (Kunth) Britton (Asteraceae) and *Plantago wrightiana* Decne. (Plantaginaceae) on a sandy roadside near a lake (34.745192, -79.484645 W), and *Triodanis biflora* (Ruiz & Pav.) Greene (Campanulaceae) in a lawn (34.741763 N, -79.486071 W). At Leigh Farm Park in the Piedmont, TSF collected leaves of *Chrysogonum virginianum* L., *Chrysopsis mariana* (L.) Elliott (Asteraceae), and *Scutellaria integrifolia* L. (Lamiaceae) in low secondary mixed pine-hardwood forest (35.916895 N, -78.979875 W), and leaves of *Dichanthelium* (Hitchc. & Chase) Gould (Poaceae) in a nearby hardwood forest (35.919397 N, -78.981134 W). *Polygala verticillata* L. (Polygalaceae) material was collected in upland mixed hardwood forest along Wooden Bridge Road in the Korstian division of Duke Forest Teaching and Research Laboratory, an asset of Duke University (35.981908 N, -79.032860 W). Leaves of *Dichanthelium dichotomum* (L.) Gould were collected in a backyard garden along Pelham Road in Durham (approximate location 35.891 N, -78.91 W), and *Pyrrhopappus carolinianus* (Walter) DC. (Asteraceae) on a sandy roadside in North Durham (36.053951 N, -78.873800 W).

Mines were photographed at the time of collection. Leaves containing agromyzid larvae or puparia were placed in sealed, 9- or 15-dram plastic vials, which were stored away from direct sunlight and checked daily (when possible) for emerging insects. When puparia were formed outside the leaves, they were transferred to a fresh vial into which a moistened, crumpled piece of tissue paper had been added to prevent desiccation. Leaves that were intact when larvae or adults exited were pressed and saved for later study. Overwintering puparia of additional material collected in New England by CSE were stored in a refrigerator at 1–3 °C from 1 November 2016 to 1 April 2017.

When an adult fly appeared in a rearing vial, it was chilled overnight in a refrigerator so that it could be photographed alive before it was preserved. CSE photographed the flies on a white dinner plate inside a transparent plastic bag using a Canon EOS Rebel XSi SLR digital camera, MP-E 65 mm macro lens, and Macro Twin Lite MT-24EX flash unit. The chilled fly was deposited onto the plate by tapping the open end of the vial on the plate, and the lens was inserted through the open end of the bag. The bag was used for recapturing the insect if it began to fly: after quickly removing the lens from the bag, one hand was used to hold the bag closed tightly around the wrist of the other hand, which held a vial in which the fly could be trapped.

All specimens (including holotypes and paratypes) were preserved in 95% ethanol and later critical point dried, glued to pins or paper points, and deposited in the Canadian National Collection of Insects, Arachnids & Nematodes (CNC). The prefix “#CSE” in the Material examined sections refers to collection events; alphanumeric codes with the prefix “CNC” are unique identifiers assigned to individual specimens. The first date listed for each collection event indicates when the leaf mines were collected, and “em.” precedes the date(s) of adult emergence; “ex” before a plant name indicates that the specimens were reared from this plant and not merely collected on it as adults.

The abdomens of dissected males were prepared by maceration in hot lactic acid followed by washing in ethanol; these are stored in glycerin in genitalia vials pinned with the specimens. Terminology follows that in Lonsdale (2011), with the exception that vein terminology follows Cumming & Wood (2017); *ori* refers to the inclinate fronto-orbital setae; *ors* refers to the reclinate posterior fronto-orbital setae. Illustrated structures are shown in size proportionately to each other, with the epandrium reduced due to space constraints; some structures were not illustrated if they were damaged, could not be found (ejaculatory apodeme), or were uninformative for diagnosis within the genus. Due to the importance of male genitalic features in species-level diagnosis of agromyzids, several female specimens listed below are only tentatively assigned to species, or only identified to genus; in these cases, specimens examined are listed under separate headings for species, or treated as “*Ophiomyia* sp. 1” and “*Ophiomyia* sp. 2”.

An asterisk before a country or state or a plant family, genus, or species name indicates a new distribution or host record confirmed by rearing. Previous distribution records are from Spencer (1969) for Canada, and Spencer & Steyskal (1986) for the USA and elsewhere, unless otherwise indicated. Host records from outside North America (Benavent-Corai *et al.* 2005; Ellis 2018) are not included here, but were considered when determining whether our records were new. Plant taxonomy follows USDA, NRCS (2018); literature records have been brought into agreement with this classification without comment.

Results and discussion

Subfamily Agromyzinae

Agromyza arundinariae spec. nov.

(Figs. 1–2, 26–27, 50–56)

Holotype. NORTH CAROLINA: Moore Co., Aberdeen, Aberdeen Lake Park, 2.vi.2017, T.S. Feldman, ex *Arundinaria tecta*, em. 24.vi.2017, #CSE3852, CNC939834 (1♂).

Tentatively identified material. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 23.vi.2015, em. 7.vii.2015, T.S. Feldman, ex *Arundinaria tecta*, #CSE2005, CNC564621, CNC564622 (1♀ (unemerged, macerated and stored in glycerin) 1 puparium).

Etymology. The specific epithet is derived from the host genus name, *Arundinaria* Michx.

Host. Poaceae: *Arundinaria tecta* (Walter) Muhl.

Leaf mine. (Figs. 26–27) The greenish mine begins with a cluster of oviposition punctures in the distal half of the leaf, within a few mm of the margin. Two or more larvae feed together, forming a gradually widening mine that initially proceeds distally, then reverses direction and may reach the base of the leaf. The frass is mostly liquidy and indistinct, with a few scattered, discrete, blackish grains.

Puparium. (Fig. 2) Dark reddish-brown; formed outside the mine.

Distribution. USA: NC.

Adult description. Wing length 2.6mm (♂). Female only tentatively associated due to similarity of leaf mine; unemerged and in poor condition, but visible features do not disagree with those of the male. Costa extending to M_1 . Length of ultimate section of vein M_4 divided by penultimate section: 0.6. Eye height divided by gena height: 10.7. First flagellomere rounded, distal margin with slightly longer hairs that include a small, round whitish medial tuft (visible anteriorly). Ocellar triangle restricted to tubercle. Thorax with light pruinosity.

Chaetotaxy: Two ors, two ori, decreasing in length anteriorly. Few minute setulae on anteromedial margin of frons. Postvertical seta approximately as long as posterior ori; ocellar seta shorter, nearly as long as anterior ori. Four dorsocentrals, with only posterior two setae well-developed; anterior two setae thin and positioned close to second postsuturally; second seta almost as long as first seta, third approximately ? length of second seta, fourth almost setula-like. Acrostichal seta strong, as long as second dorsocentral. Ten rows of acrostichal setulae. Mid tibia with two strong posteromedial setae.

Coloration: (Fig. 1) Setae black. Body dark brown; wing veins yellowish, especially to base; halter white.

Genitalia: (Figs. 50–56) Epandrium broadly rounded, shallow, fused to surstylus. Surstylus darkly pigmented, small, slightly lobate anterodistally; distal margin setose, and with irregular basal to medial cluster of small, rounded tubercle-like setae. Cercus long, finger-like. Hypandrium stout, inner-margin weakly sclerotized, basal lobe relatively broad, long, and with two minute setae near straight inner margin; apex pointed, with narrowing apodeme as long as inner lobe. Postgonite lobate with cluster of nine minute inner-medial setulae; with long, curved band-like process basally that meets phallopodeme; basal process densely and minutely spinulose on basal half. Phallopodeme with short basal wall, and long dorsal wall that fuses to right sclerite of basiphallus. Distal third of basiphallus very dark with subtriangular apical section strongly incurved; bases nearly meeting dorsally past phallopodeme; left sclerite with ventrally curving process at base. Hypophallus small, weakly sclerotized. Distal section of phallus typical of most grass-feeding *Agromyza*, with mesophallus and distiphallus fused into long, capsule-like structure with base sinuate (seen laterally) and ejaculatory duct inserted into wide ventrobasal fissure; apex weakly and minutely tuberculate, slightly expanded when viewed laterally; distal section relatively long,

making composite structure as long as basiphallus, with ventral suture bordering long, narrow tear-drop shaped plate; seen ventrally, distal section past basiphallus with narrow parallel-sided base before swollen, rounded apex; distal margin produced backwards as short, weak dorsal plate. Ejaculatory apodeme with wide asymmetrical base, short stem that grades onto well-developed and apically clear blade; stem and blade with offset medial “rib”; sperm pump large, clear.

Comments. This new species differs from most *Agromyza* in being entirely dark, including the marginal hairs on the calypter, but excluding the margin of the calypter itself and the halter. There is also a small, round apical tuft of hairs of the first flagellomere and there are two strong posteromedial setae on the mid tibia. Externally, it is not readily differentiated from many other similar eastern grass-feeders, especially *A. parilis* Spencer (see Spencer & Steyskal (1986: Figs. 426, 427)), requiring male dissection. The distiphallus is distinct when viewed ventrally in that it has a narrow parallel-sided section before a swollen, rounded apex, and the incurved apices of the basiphallus are especially dark.

This is the first record of an agromyzid from the bamboo genus *Arundinaria* s.s., along with two additional new species we describe later in this paper, *Cerodontha (Poemyza) arundinariella* and *C. (P.) saintandrewsensis*. The Palearctic species *C. (P.) bisetiorbita* (Sasakawa) has been recorded from *Arundinaria pygmaea* var. *glabra* (Makino) Ohwi (Sasakawa 1955, 1961), a synonym of *Pleioblastus fortunei* (Van Houtte) Nakai.

***Agromyza indistincta* spec. nov.**

(Figs. 3–4, 28, 57–63)

Holotype. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 9.v.2017, em. 9–13.vi.2017, T.S. Feldman, ex *Dichantheium*, #CSE3807, CNC939776 (1♂).

Paratypes. Same data as holotype, CNC939775, CNC939777 (2♀).

Etymology. The specific epithet refers to the similarity of both the leaf mine and the adult to those of other *Agromyza* species on the same host plant.

Host. Poaceae: *Dichantheium* (Hitc. & Chase) Gould.

Leaf mine. (Fig. 28) Similar to the mine of *Agromyza arundinariae* described above. Two of the specimens were reared from one mine and the third was reared from a solitary larva in a separate leaf.

Puparium. (Fig. 4) Brown; formed outside the mine.

Distribution. USA: NC.

Adult description. Wing length 2.2 mm (♂), 2.8–2.9 mm (♀). Costa extending to M_1 . Length of ultimate section of vein M_4 divided by penultimate section: 0.8–0.9. Eye height divided by gena height: 6.6–10.1. First flagellomere small, rounded; distal margin with slightly longer hairs, medially with small denser circular tuft. Face with shallow carina. Male frons rounded and slightly projecting anterodorsally. Ocellar triangle slightly longer than wide, apex somewhat rounded and nearly reaching level of anterior ors. Ocellar triangle and orbital plate slightly shinier. Thorax subshining.

Chaetotaxy: Two ors, two ori, becoming slightly shorter anteriorly; male and one female with additional smaller, thinner ori on one side; one female with three ori on both sides. One row of orbital setulae. Ocellar and postvertical setae subequal to fronto-orbitals. Two dorsocentral setae, anterior seta slightly shorter. Acrostichal seta strong, as long as anterior dorsocentral. Acrostichal setulae in eight straight to irregular rows. Mid tibia with two strong posteromedial setae.

Coloration: (Fig. 3) Setae dark brown with paler brown shine. Body mostly dark brown with halter white; frontal vitta (excluding ocellar triangle) brown; female orbital plate (excluding around base of setae) and parafacial paler brown, sometimes whitish; antenna brown with inner surface of pedicel paler, and first flagellomere darker brown distally and yellowish basally on inner surface; gena brown with ventral margin dark brown; male antennal groove paler dorsally; female with minute faded light yellow to whitish spot at anterior corner of scutellum and with similarly pale region above wing base; apex of fore femur very narrowly light yellow; posteromedial surface of hind femur pale and desclerotized; base of fore tibia yellow, with length of spot exceeding width; fore tarsus light yellow, mid and hind tarsus brown with dirty white tint with hind tarsi darker. Calypter margin and hairs dark brown.

Genitalia: (Figs. 57–63) Epandrium wide, shallow; inner-ventral margin fused to surstylus. Surstylus small,

rounded, inner surface with many small, tubercle-like setae. Cercus large. Hypandrium broadly arched with strong terminal apodeme; inner lobe with short medial setae, broad, subquadrate with inner margin weak and confluent with small haired membrane; basal arms much reduced. Pregonite with narrowly rounded ventral lobe that has few short setae on inner surface, basally with longer, weaker, subquadrate lobe, posteromedial margin with extremely elongate, spinulose anterobasal process that curves anterodorsally to fuse with phallopodeme. Phallopodeme wider at base, asymmetrical with left dorsolateral margin produced and fused to right sclerite of basiphallus. Both sclerites of basiphallus converging to base and with lateromedial membranous lobe that is larger on right side; apical third dark, weakly connected to basal section and abruptly directed inwards with apices perpendicular to long axis of phallus. Distiphallus of “*nigripes*-type” (capsule-shaped with subbasal crack-like slit for entry of ejaculatory duct, pronounced dorsobasal collar and medial convolution), with medial bend shallow and distiphallus nearly straight; distal section past this deviation slightly longer and wider than basal section, sides nearly subparallel in ventral view with abruptly widened base, with slight medial swelling and bulbous apical section that appears especially large and rounded in lateral view. Ejaculatory apodeme with short stem expanding into wide blade that is minutely striated and clear apically; stem and blade with dark medial rib; base very wide, strongly produced towards duct, distal side with long, thin, clear tubule; sperm sac large, clear.

Comments. *Agromyza indistincta* is highly similar to other dark, grass-feeding congeners with a “*nigripes*-type” phallic structure, including *A. parca* Spencer and *A. pudica* Spencer (keying to couplet 31 in Spencer & Steyskal (1986)). These species have also been reared from *Dichantheium* (Eiseman & Lonsdale 2018) and have only two well-developed dorsocentrals, and a minute apical tuft of hairs on the first flagellomere. Externally, *A. indistincta* differs in that the apical tuft on the antenna is present in both sexes, the calypter hairs are dark brown in both sexes, the eye is 6.6–10.1 times higher than the gena (usually less than 5.0, but as large as 6.7 in some *A. parca*), and the apex of the fore femur is very narrowly light yellow. The basiphallus and distiphallus are most characteristic; the basiphallus is apically narrow, undivided, relatively dark and sharply angled inwards; the distal section of the distiphallus after the medial curve is angled along nearly the same plane as the basal section and not strongly deviated (i.e. the distiphallus is unusually straight), this distal section is only slightly longer but abruptly wider than the basal section, and the sides of the distal section are subparallel excluding a slight medial bulge and a unique apical chamber that is more strongly swollen dorsally. Another species reared from *Dichantheium* is *A. proxima* Spencer (Scheffer & Lonsdale 2018), but that species is more similar to other *Agromyza* with a buckled, paler brown to orange frons and yellowish lunule.

***Ophiomyia beckeri* (Hendel)**

(Figs. 5, 29)

Material examined. NORTH CAROLINA: Durham Co., Durham, Pelham Road, 13.vi.2015, em. 16.vi.2015, T.S. Feldman, ex *Sonchus*, #CSE1619, CNC564619 (1♂); Durham, 17.vii.2015, em. by 3.viii.2015, T.S. Feldman, ex *Sonchus asper*, #CSE2120, CNC564631 (1♂); Scotland Co., Laurinburg, St. Andrews University, 10.iv.2017, em. 16–18.v.2017, T.S. Feldman, ex *Krigia virginica*, #CSE3677, CNC939735, CNC939736 (2♂).

Hosts. Asteraceae: **Krigia virginica* (L.) Willd., *Sonchus* L.

Leaf mine. (Fig. 29) Larva primarily boring in the leaf midrib, making short corridors into the blade and sometimes overlying the midrib. The branches are virtually free of frass, which accumulates in the larva’s resting place at the base of the midrib (Ellis 2018).

Puparium. Yellowish-white or sometimes black, formed in the base of the midrib (Ellis 2018).

Distribution. *USA: NC; Africa; Asia; Europe.

Comments. This is the first record of any agromyzid from *Krigia* Schreb. TSF has also found an undetermined species of *Liriomyza* Mik mining leaves of *K. virginica* at St. Andrews University.

***Ophiomyia* sp. 1**

(Figs. 30–31)

Material examined. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 2.vi.2015, em. by 17.vi.2015, T.S. Feldman, ex *Hypochaeris chillensis*, #CSE2007 (1♀).

Host. Asteraceae: *Hypochaeris chillensis* (Kunth) Britton.

Leaf mine. (Figs. 30–31) The single photographed mine was whitish, beginning as a narrow, linear track on the lower leaf surface, then entering the midrib and petiole, where most feeding took place, including on the upper leaf surface, where there was a blotch-like expansion into the blade.

Puparium. Formed within the mine.

Comments. The leaf mine seems consistent with *Ophiomyia beckeri*, which has been found at the same location and is recorded from *Hypochaeris* L. in Europe (Hering 1957, p. 557). The reared adult is unfortunately in very poor condition, with the head and most legs missing, in addition to being a female. TSF has found similar midrib-based mines on *H. radicata* L. at both St. Andrews University and in Durham.

***Ophiomyia* sp. 2**

(Figs. 6, 32)

Material examined. NORTH CAROLINA: Durham Co., Durham, 23.v.2017, em. 25.v.2017, T.S. Feldman, ex *Pyrrhopappus carolinianus*, #CSE3714 (1♀).

Host. Asteraceae: *Pyrrhopappus carolinianus* (Walter) DC.

Leaf mine. (Fig. 32) Whitish, on the upper leaf surface; primarily over the midrib, with occasional short excursions into the blade. Although the leaf from which the adult was reared had no mining on the lower surface, TSF has found similar mines on this host with associated lower surface tracks as with *Ophiomyia* sp. 1.

Puparium. (Fig. 6) Whitish; formed within the mine, with the anterior spiracles projecting through the upper epidermis.

Comments. Although the leaf mine seems consistent with *Ophiomyia beckeri*, the single reared female cannot be identified. This is the first published record of any agromyzid from *Pyrrhopappus* DC. M.W. Palmer (*in litt.*) has found *Ophiomyia* mines on stems of *P. carolinianus* in Oklahoma.

Subfamily Phytomyzinae

***Calycomyza avira* Eiseman & Lonsdale**

Material examined. NORTH CAROLINA: Durham Co., Durham, Grandale Drive, 14.vii.2017, em. 1–3.viii.2017, T.S. Feldman, ex *Bidens aristosa*, #CSE4047, CNC939843, CNC939844 (1♂ 1♀).

Hosts. Asteraceae: *Bidens* **aristosa* (Michx.) Britton, *B. frondosa* L. (Eiseman & Lonsdale 2018).

Leaf mine. A whitish, upper surface blotch with frass in scattered grains and small lumps, sometimes with a short initial linear portion evident.

Puparium. Reddish-brown; formed outside the mine.

Distribution. USA: CT, MA, NC, NY, WV (Eiseman & Lonsdale 2018).

Comments. These specimens were listed as paratypes by Eiseman & Lonsdale (2018), but the host was only listed as *Bidens*; TSF determined the plant species after the specimens were labeled.

***Calycomyza chrysopsidis* spec. nov.**

(Figs. 7–8, 33–34, 64–67)

Holotype. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 24.v.2016, em. 8–13.vi.2016, T.S. Feldman, ex *Chrysopsis mariana*, #CSE2573, CNC654293 (1♂).

Paratype. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 10.vii.2017, em. 22.vii.2017, T.S. Feldman, ex *Chrysopsis mariana*, #CSE3992, CNC939774 (1♂).

Tentatively identified material. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 26.vi.2017, em. 29.vi.2017, T.S. Feldman, ex *Chrysopsis mariana*, #CSE3869 (empty puparium; adult lost).

Etymology. The specific epithet refers to the host plant, *Chrysopsis* (Nutt.) Elliott (Asteraceae).

Host. Asteraceae: *Chrysopsis mariana* (L.) Elliott.

Leaf mine. (Figs. 33–34) Upper surface, whitish, with areas of brownish discoloration; initially linear, becoming an elongate, irregular blotch, sometimes with digitate projections. The brown frass is deposited in a single lump just before pupation.

Puparium. (Fig. 8) Brown; formed within the mine adjacent to the frass lump.

Distribution. USA: NC.

Adult description. Wing length 1.8mm (♂). Female unknown. Length of ultimate section of vein M_4 divided by penultimate section: 2.3. Costa extending to M_1 . Eye height divided by gena height approximately 4.3. Body in poor condition with pale residue on parts. First flagellomere rounded. Arista pubescent. Notum with faint grayish pruinosity.

Chaetotaxy: Two ors, three ori; setae decreasing in length anteriorly. Ocellar and postvertical setae subequal to ors, ocellar slightly thinner. Three dorsocentral setae with anterior seta approximately $\frac{2}{3}$ length of second seta. Six rows of acrostichal setulae. Mid tibia apparently with one lateromedial seta.

Coloration: (Fig. 7) Setae black. Head light yellow with antenna, back of head, posterolateral corner of frons to base of inner vertical, clypeus and palpus black; faint blackish pigment on orbital plate laterally to level of anterior ors, with extensions of band to reach base of setae, anteriorly continuing as very faint narrow line; frons with grayish pruinosity on dark regions. Thorax black with postpronotum (excluding large anterior spot) and notopleuron light yellow; region above alar base slightly yellowish. Calypter entirely white. Haltere white. Abdomen and legs black.

Genitalia: (Figs. 64–67) External genitalia of typical *Calycomyza* morphology; surstyli slightly asymmetrical, with tighter posterior clustering of tubercles on left surstylus and long regular setae present anteriorly on right surstylus. Basiphallus dominated by left sclerite, which tapers posterodorsally and widens apically in split that fuses to both halves of hypophallus, which are long, narrow and mostly parallel with apex incurved; right sclerite of basiphallus narrowly triangular with very long tapered base. Paraphallus a broad, membranous lobe with ventral band-like sclerotization that is mostly faint and ill-defined with base dark. Mesophallus swollen laterally to form circular base; ? as high as long (lateral view), and over ? as wide as long (ventral view). Distiphallus ? length of mesophallus, entirely divided medially, dark, constricted at apex and base and enclosing internal fringed structures. Ejaculatory apodeme stout, broad, blade fan-shaped with paler apex; sperm pump with lateral lobes bearing narrow sclerotized bands that are confluent with pigmented base of duct; duct minutely annulated.

Comments. *Calycomyza chrysopsidis* is a relatively pruinose species (more densely covered with pruinosity than congeners considered “subshining”) with a pure white calypter, entirely black legs and a stripe on the orbital plate that is relatively wide to the level of the anterior ors and very narrow beyond. The general structure of the phallus is similar to that of *C. promissa* (Frick), having a short, medially split distiphallus and no ventrobasal process on the mesophallus, but the strongly swollen mesophallus is distinct, with the basal half broadly subcircular in outline when viewed ventrally.

Chrysopsis is a new host genus for Agromyzidae.

***Calycomyza novascotiensis* Spencer**

(Figs. 35–36)

Material examined. NORTH CAROLINA: Durham Co., Durham, 15.vi.2015, em. by 6.vii.2015, T.S. Feldman, ex *Scutellaria integrifolia*, #CSE1681, CNC564726 (1♂).

Host. *Lamiaceae: *Scutellaria integrifolia* L.

Leaf mine. (Figs. 35–36) A gradually widening, serpentine track, expanding to a blotch that may obliterate the earlier portion; whitish, largely discolored brown; frass in scattered grains (more closely spaced in the earlier portion).

Puparium. Yellowish-brown to brown; formed outside the mine.

Distribution. *USA: NC; Canada: NS (Spencer 1969).

Comments. *Scutellaria* is a new host genus for *Calycomyza* and for any North American agromyzid. Since *S. integrifolia* does not occur in Nova Scotia, this fly must have another host. *Scutellaria galericulata* L. and *S.*

lateriflora L. are the only congeners recorded from Nova Scotia (USDA, NRCS 2018), and we have never found agromyzid mines on either of these plants.

***Calycomyza platyptera* (Thomson)**

Material examined. NORTH CAROLINA: Durham Co., Durham, Grandale Drive, 14.vii.2017, em. by 24.vii.2017, T.S. Feldman, ex *Bidens aristosa*, #CSE4007, CNC939842 (1♂).

Hosts. Asteraceae: *Ambrosia artemisiifolia* L., *Artemisia ludoviciana* Nutt., *Bidens *aristosa* (Michx.) Britton, *Gamochaeta pensylvanica* (Willd.) Cabrera, *Helianthus annuus* L., *H. exilis* A. Gray, *Iva frutescens* L., *Mikania micrantha* Kunth, *M. scandens* (L.) Willd., *Silphium laciniatum* L., *S. perfoliatum* L., *Xanthium strumarium* L. (Eiseman & Lonsdale 2018 and references therein; see that paper for discussion of other reported hosts that require confirmation).

Leaf mine. A whitish blotch, frequently toward the base of the leaf, with characteristic irregular offshoots; an initial short, linear portion is usually obliterated by the blotch. Frass is mostly deposited in a mass of coalescing pellets around the pupation site.

Puparium. Brownish, attached to a flattened lump of frass at the center of the mine.

Distribution. USA: CA, CO, FL, IA, KS, MA, MS, NC, OK; Cuba; Grand Cayman Island; Jamaica (Eiseman & Lonsdale 2018).

Comments. This specimen was listed by Eiseman & Lonsdale (2018), but the host was only listed as *Bidens*; TSF determined the plant species after the specimen was labeled.

Cerodontha (Butomomyza) enigma spec. nov.

(Figs. 9–10, 37, 68–73)

Holotype. NORTH CAROLINA: Durham Co., Durham, Pelham Road, 14.v.2017, em. 4.vi.2017, T.S. Feldman, ex *Dichantheium dichotomum* ssp. *nitidum*, #CSE3790, CNC939826 (1♂).

Etymology. The specific epithet refers to the quandary posed by this unique specimen, which is so similar to *Cerodontha angulata* (Loew) in both leaf mine and adult morphology.

Host. Poaceae: *Dichantheium dichotomum* (L.) Gould.

Leaf mine. (Fig. 37) The mine of the single known specimen was primarily on the upper leaf surface, where it consisted of irregular elongate branches and was mostly whitish and greenish with a few patches of reddish discoloration. A small area toward the apex of the lower leaf surface was also mined, forming an irregular whitish patch with dark frass in several small lumps and grains.

Puparium. (Fig. 10) Oval, reddish-brown; formed within the mine.

Distribution. USA: NC.

Adult description. Wing length 2.4 mm (♂). Female unknown. Length of ultimate section of vein M_4 divided by penultimate section: 0.8. Costa extending to M_1 . Eye height divided by gena height: 22.0. First flagellomere small, rounded, apical margin with longer hairs. Frontal vitta minutely textured. Ocellar triangle not evident. Lunule velvety, shape typical of other *Butomomyza*. Thorax subshining.

Chaetotaxy: Two ors, two ori, becoming shorter anteriorly. Orbital setulae short, numerous and closely spaced. Postvertical and ocellar setae subequal to ori. Five dorsocentral setae, fifth seta presutural, first much stronger; second seta approximately ? length first seta, fifth seta approximately $\frac{1}{2}$ first seta; first pair of setae widely spaced, setae pairs two to five convergent posteriorly with second pair strongly inset. Acrostichal seta subequal to anterior dorsocentral. Acrostichal setulae in approximately six to eight scattered rows. In addition to upcurved dorsomarginal setae typical of subgenus, katepisternum with additional dense cluster of upcurved setae anteroventral to base of dominant seta. Mid tibia with two posteromedial setae.

Coloration: (Fig. 9) Setae black. Body dark brown with calypter and halter yellow; frons, lunule and gena brownish-beige with ocellar tubercle dark brown, lateral margin of orbital plate brown and posterolateral corner of frons to base of inner vertical seta dark brown; wing veins light yellow, only brown apically; apex of fore femur light yellow with spot as long as wide; fore tibia light yellowish-brown; tarsi light yellow with apical two segments browner.

Genitalia: (Figs. 68–73) Epandrium very broad with small, rounded supra-anal process directed posteriorly. Surstylus small, fully fused to inner anteroventral margin of epandrium and not visible laterally; with irregular vertical row of six or so long tubercle-like setae. Subepandrial sclerite mostly reduced to one pair of dark, widely divided, curved ventral arms with strong outer subapical points. Hypandrium strongly arched, arms narrowest medially, with sclerotized marginal band and anteromedial line; inner lobe narrow, transverse, anterior margin irregular, several fossae present near base; arm of hypandrium basal to inner lobe strongly reduced. Pregonite narrow, darker and rounded apically. Phallophorus cylindrical, slightly elongate. Basiphallus short, not much longer than phallophorus, halves approximate on medial left-dorsal surface; left sclerite weak and ill-defined (more so apically), base slightly more ventral in position, apex wider with dorsal margin produced and irregular; right sclerite broadest medially, apex narrowed and strongly deviated, extending along right surface past base of mesophallus. Hypophallus large, trilobed and membranous with long, narrow medial tubule that is anterobasally sclerotized and extends around apex of medial lobe; right lobe with broad, weak diffuse sclerotization basally; sclerite on left lobe more well-defined, darker to base; left lateral margin past sclerite with additional faint medial and subapical sclerotizations. Paraphallus lobate, almost spherical with posteroventral sclerotized patch; left paraphallus with additional lobe that is similarly spherical and with a ventral, transverse sclerotized patch that is narrowed medially and posteriorly connected to patch on ventral lobe. Mesophallus dark, narrow, nearly as long as basiphallus, and divided into long basal stem and apical bulb; width of stem less than one fifth length, with shallow, weak distoventral carina; bulb slightly more than one third length of stem, basal margin appearing bilobed when viewed ventrally, length and height subequal, width greater by one half; space between mesophallus and distiphallus equal to length of mesophallus bulb. Distiphallus entirely divided into two long, dark tubules that are directed dorsally, slightly diverging apically, shallowly sinuous, and as long as mesophallus; apex slightly wider and straighter, shallowly bulging subapically; distal curve minutely textured dorsally. Ejaculatory apodeme not found.

Comments. While superficially similar in overall appearance to other *Butomyza*, *Cerodontha enigma* differs strikingly from all related taxa in two aspects of chaetotaxy: there are five dorsocentrals, with the posterior pair widely spaced and the anterior four pairs converging posteriorly; the katepisternum has a dense cluster of long upcurved setae anterior to the base of the dominant seta. Furthermore, the gena is exceptionally narrow, and while the genitalia are similar to those of other locally occurring species, including the relatively common *C. angulata* (see Spencer & Steyskal (1986: Figs. 583–586)), there is a small supra-anal process, the left paraphallus is bilobed, the mesophallus is longer with a smaller apical lobe and the distiphallus is straighter.

We have repeatedly reared *Cerodontha angulata* from similar mines on *Dichanthelium* spp. in both Massachusetts and North Carolina (Eiseman & Lonsdale 2018). In that species the mine usually begins with a dark, trumpet-shaped area along the midrib, and the larva initially mines toward the apex of the leaf. A single blackish patch of frass is deposited at the point where the larva reverses direction. CSE has also found a single presumed *C. angulata* mine that was formed entirely on the lower surface, but no individual has been observed to mine both leaf surfaces. Since the present mine description for *C. enigma* is based on a single example, additional rearings will be required to characterize this species in comparison with *C. angulata*.

***Cerodontha (Poemyza) arundinariella* spec. nov.**

(Figs. 11–12, 38, 74–81)

Holotype. NORTH CAROLINA: Moore Co., Aberdeen, Aberdeen Lake Park, 2.vi.2017, em. 29.vi.2017, T.S. Feldman, ex *Arundinaria tecta*, #CSE3870, CNC939846; (1♂, CNC).

Paratypes. Same data as holotype, CNC939845, CNC939847 (2♀, CNC).

Etymology. The specific epithet is derived from the host genus name, *Arundinaria* Michx.

Host. Poaceae: *Arundinaria tecta* (Walter) Muhl.

Leaf mine. (Fig. 38) Probably not distinguishable from that of *Cerodontha saintandrewsensis*. The mine that produced the type series was equally visible on both leaf surfaces and contained five larvae.

Puparium. (Fig. 12) Elongate, brown; formed within the mine (specimens not preserved; prominent posterior spiracular horns visible in photos of leaf mine, but details unknown).

Distribution. USA: NC.

Adult description. Wing length 2.2 mm (♂), 2.4 mm (♀). Length of ultimate section of vein M_4 divided by penultimate section: 1.4. Costa extending to M_1 . Eye height divided by gena height: 11.1–15.0. First flagellomere small, rounded. Frontal vitta minutely textured. Ocellar triangle not evident. Lunule high, width ? height, apex truncated; sides slightly converging with distal $\frac{1}{3}$ more sharply angled inwards; surface minutely pitted dorsolaterally. Buccal cavity with dense, black spicules between arms of clypeus. Thorax with light pruinosity.

Chaetotaxy: Two ors, two ori, shorter anteriorly. Orbital setulae short, numerous. Postvertical and ocellar setae subequal to ors. Three dorsocentral setae, only first seta strong; second seta approximately ? length of first, third approximately half length of second. Acrostichal seta absent. Acrostichal setulae in approximately six irregular rows. Mid tibia without posteromedial seta.

Coloration: (Fig. 11) Setae black. Body mostly dark brown; pedicel orange on inner surface; orbital plate paler with inner margin light brown to beige; lunule and gena (excluding dark brown venter) with beige tint; face with beige mottling; notopleuron slightly paler, more yellowish medially in female; postalar wall with whitish-yellow spot; calypter margin pale, hairs golden in male and golden-brown to light brown in female; wing veins light yellow, brownish apically; femora apices light yellow with spot as long as wide; tibiae yellower at base, posterior legs darker, fore leg paler and more whitish at both base and apex; tarsi with dirty white tint that is more pronounced on fore legs.

Genitalia: (Figs. 74–81) Epandrium with distoventral region slightly produced and with small patch of small setae on inner surface; with rounded subconical supra-anal process that is angled dorsally and widest at base. Surstylus small, rounded, strongly directed inwards, without tubercle-like setae, and fused to anteroventral margin of epandrium. Subepandrial sclerite broadly split medially and with ventromedial seta; ventral process dark, short, weakly curved, with shallow outer subapical point. Hypandrium and pregonite, small, typical of genus. Phalophorus cylindrical, ventral margin produced as lobate plate extending onto left lateral surface of shaft; fused to chevron-shaped left lateral sclerite of basiphallus; right sclerite of basiphallus narrow, short, distal and slightly exceeding base of mesophallus. Paraphallus small, clear, lobate, left side slightly larger and bilobed. Hypophallus large and broadly rounded with narrower darker base; with short medial flagellum; distal margin irregularly sclerotized. Mesophallus with short stem that narrows apically; width at midpoint approximately one third length; with small apical bulb that in lateral view is shallowly concave and downturned, and in ventral view is basally bilobed with sides subparallel; fused to distiphallus. Distiphallus split into two long, narrow, subparallel tubules approximately as long as basiphallus+phalophorus; broadly and shallowly arched along most of length, base with short abrupt curve; paler apically before slightly wider terminal sclerotized cylinder that is slightly longer than wide. Ejaculatory apodeme pale, stem grading into relatively well-developed blade; base stout, asymmetrical; sperm pump clear.

Comments. See comments for *Cerodontha saintandrewsensis*.

The mines of this species are not only similar to those of *Cerodontha saintandrewsensis*, but also to *Agromyza arundinariae*. In fact, they were collected along with the latter species at Aberdeen Lake Park and the two were not distinguished in the field. The difference became obvious when the *Agromyza* larvae (which were presumably yellowish-white as is typical of the genus) emerged from their mines to pupate, while the blue-green *Cerodontha* larvae formed their puparia within the leaf. We have noted this blue-green color in mature larvae of other *Cerodontha* (*Poemyza*) species (*C. incisa* (Meigen) and *C. inconspicua* (Malloch)), and we presume it is also present in *C. saintandrewsensis*, whose larvae were not observed. The abdomen of teneral adults of *C. arundinariella* is likewise blue-green.

***Cerodontha (Poemyza) saintandrewsensis* spec. nov.**

(Figs. 13–14, 39, 82–89)

Holotype. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 2.vi.2017, em. 2–7.vii.2017, T.S. Feldman, ex *Arundinaria tecta*, #CSE3888, CNC939761 (1♂).

Paratypes. Same data as holotype, CNC939760, CNC939762–939764 (2♂ 1♀ 1 puparium, CNC).

Etymology. This species is named for the type locality, St. Andrews University in Laurinburg, North Carolina.

Host. Poaceae: *Arundinaria tecta* (Walter) Muhl.

Leaf mine. (Fig. 39) A greenish blotch containing several larvae, with frass in scattered dark grains. As with the mine of *Agromyza arundinariae* it is initially relatively narrow and at first proceeds distally, then reverses direction; however, it may begin at the center of the leaf rather than near the margin.

Puparium. (Fig. 14) Elongate, brown, with prominent Y-shaped posterior spiracular horns; formed within the mine.

Distribution. USA: NC.

Adult description. Wing length 2.3–2.4 mm (♂), 2.2–2.3 mm (♀). Length of ultimate section of vein M_4 divided by penultimate section: 1.1–1.3. Costa extending to M_1 . Eye height divided by gena height: 10.0–12.5. First flagellomere small, rounded. Frontal vitta minutely textured. Orbital plate nearly $\frac{1}{3}$ width of frons. Ocellar triangle round, not much larger than tubercle. Lunule subtriangular, sides converging dorsally with broad, truncated apex; width ? height; minutely and shallowly pitted, smoother ventromedially. Buccal cavity with dense, black spicules between arms of clypeus. Subshining, thorax with slightly denser dusting of fine pruinosity.

Chaetotaxy: Two ors, two ori. Ocellar setae short, numerous. Postvertical and ocellar setae subequal to ors. Two dorsocentral setae, anterior seta approximately ? length. Acrostichal seta absent. Acrostichal setulae in approximately six to seven irregular rows. Mid tibia with one posteromedial seta.

Coloration: (Fig. 13) Setae black. Body mostly dark brown; pedicel with orange tint and distal margin strongly orange; frontal vitta and gena with beige tint, inner margin of orbital plate beige, face mottled beige; postalar wall with faded whitish-yellow area; calypter margin yellow, hairs darker yellow, golden; wing veins light yellow at base, on crossveins, CuA , and M_1 to midpoint of ultimate section; femora apices light yellow with spot almost as long as wide on fore leg, shorter on mid leg, and faded and narrow on hind leg; base of fore tibia light yellow.

Genitalia: (Figs. 82–89) Epandrium slightly produced posteroventrally; with bare, rounded supra-anal process that is longer than wide and constricted at base; setose with denser patch of small setae on inner posteroventral surface. Surstylus small, rounded, without tubercle-like setae; directed inwards, fused to anteroventral margin of epandrium. Subepandrial sclerite widely split medially, with one inner-ventral seta; dark ventral process of sclerite with broad base curved outwards, ventral arm short, narrow, with shallow outer subapical point. Hypandrium and pregonite, small, typical of genus. Phallosphorus cylindrical, distoventrally produced as elongate left ventrobasal plate that is marginally thicker, slightly upcurved apically and closely adjoining left sclerite of basiphallus. Left sclerite of basiphallus nearly linear, wrapping under shaft of phallus basally; right sclerite narrow, distal, apex exceeding base of mesophallus. Paraphallus small, lobate; right lobe clear, left lobe bifid with weak dorsal sclerotization. Hypophallus longer than basiphallus, broad and lobate; more heavily sclerotized to narrow base, with small narrow flagellum arising from desclerotized subapical section. Mesophallus stem cylindrical with darker rounded base, length five times width, with slight ventral curve; swollen apical bulb almost one third length of segment, ventrobasally bilobed, fused to distiphallus. Distiphallus split into two long tubules as long as mesophallus; tubules subparallel with membrane connecting them on basal half; slightly sinuate (lateral view) with short basal section darker and more sharply curved, middle section relatively straight, and apical third paler to clear, shallowly angled and also relatively straight; membrane adjoining apical third compressed into lightly sclerotized ventral and lateral folds that end subapically; apex with short, sclerotized cylindrical segment; distiphallus with minute, short spicules around apical sclerotized cylindrical segment and along ventral membrane on distal half. Ejaculatory apodeme almost as long as phallus, with well-developed stem and broad blade weakly sclerotized; base asymmetrical and stout; sperm pump clear.

Comments. The new species *Cerodontha arundinariella* and *C. saintandrewsensis* key to the North American *C. attenuata* Spencer (South Carolina and Tennessee) using Spencer & Steyskal (1986: couplet 9), as these have a high lunule that is apically truncated and minutely pitted, the bodies are mostly dark brown with the apices of the femora yellow (spot reduced on posterior legs of *C. arundinariella*), the calypter is pale with golden to golden-brown hairs (light brown in some *C. arundinariella*), and the ratio of the penultimate and ultimate sections of vein M_4 are similar. Additional similarities include a strong male supra-anal process that is well-developed and directed dorsally (usually reduced in *Poemyza* Hendel), the surstylus is relatively long and strongly angled inwards, the subepandrial sclerite is bilobed with the curved ventral lobe strong and relatively long, and quite unusually, the hypophallus is large and broadly sclerotized.

Both new species differ from *Cerodontha attenuata* (see Spencer & Steyskal (1986: Figs. 568, 569)) in having one pair of paraphalli with the left one bilobed (not absent). *Cerodontha saintandrewsensis* is similar to *C. attenuata* in having an orange pedicel and a long mesophallus with a rounded apical bulb, but the distiphallus is shorter, straighter and with sclerotized ventrolateral folds (Figs. 88, 89). The distiphallus of *C. arundinariella* is more similar to that of *C. attenuata*, but the base is more strongly bent and the distal section more evenly arched, and the mesophallus is shorter with a narrow apical bulb (Figs. 80, 81).

***Liriomyza carphephori* spec. nov.**

(Figs. 15–16, 41–43, 90–93)

Holotype. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 29.vi.2016, em. 17–25.vii.2016, T.S. Feldman, ex *Carphephorus bellidifolius*, #CSE2772, CNC653930 (1♂).

Paratypes. MASSACHUSETTS: Berkshire Co., Sheffield, 9.vii.2014, em. by 28.vii.2014, C.S. Eiseman, ex *Bidens frondosa*, #CSE1210, CNC384879 (1♀); Bristol Co., Easton, 42.006363, -71.086379, 12.viii.2013., em. 30.viii.2013, C.S. Eiseman, ex *Mikania scandens*, #CSE851, CNC392632 (1♀); same collection data, em. 11.iv.2014, #CSE1073, CNC384795 (1♀); Franklin Co., Northfield, 276 Old Wendell Rd. (42.646967, -72.424863), 8.x.2016, em. 2–16.v.2017, C.S. Eiseman, ex *Bidens frondosa*, #CSE3618, CNC939683–939686 (1♂ 3♀); NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 10.vii.2017, em. 23–25.vii.2017, T.S. Feldman, ex *Bidens bipinnata*, #CSE4000, CNC939778–939780 (2♂ 1♀, CNC); Scotland Co., Laurinburg, St. Andrews University, 29.vi.2016, em. 17–25.vii.2016, T.S. Feldman, ex *Carphephorus bellidifolius*, #CSE2772, CNC653929, CNC653931–653933 (2♂ 2♀); VERMONT: Rutland Co., West Haven, Helen W. Buckner Memorial Preserve (43.576347, -73.411995), 1.x.2016, em. 18.v.2017, C.S. Eiseman, ex *Bidens frondosa*, #CSE3682, CNC940121 (1♀, head missing).

Etymology. The specific epithet refers to one of the host plants, *Carphephorus* Cass. (Asteraceae).

Hosts. Asteraceae: *Bidens bipinnata* L., *B. frondosa* L., *Carphephorus bellidifolius* (Michx.) Torr. & A. Gray, *Mikania scandens* (L.) Willd.

Leaf mine. (Figs. 41–43) On *Carphephorus*, the long, whitish, entirely linear mine may be formed on either leaf surface; it is frequently formed mostly on the lower surface (Fig. 42), switching to the upper surface toward the end (Fig. 43). Frass is in black, beaded or continuous strips. Mines on *Bidens* (Fig. 41; previously discussed by Eiseman & Lonsdale (2018) under *Liriomyza* sp. 3 and illustrated in their Fig. 160) are confined to the upper surface and invariably begin at the apex of a leaflet, where they are often highly contorted before meandering elsewhere in the leaf. Mines of both types have been found together on *Mikania* (discussed by Eiseman & Lonsdale (2018) under *Liriomyza* sp. 5 and illustrated in their Fig. 162). The females treated as *Liriomyza* spp. 3 and 5 by Eiseman & Lonsdale (2018) are included here as paratypes of *L. carphephori*.

Puparium. (Fig. 16) Yellow to orange-yellow; formed outside the mine.

Distribution. USA: MA, NC, VT. Similar leaf mines on *Bidens* have been photographed in New York (Dombroskie 2018).

Adult description. Wing length 1.4–1.6mm (♂), 1.8–1.9mm (♀). Length of ultimate section of vein M₄ divided by penultimate section: 2.2–3.0. Costa extending to M₁. Eye height divided by gena height: 5.6–7.0. First flagellomere small, rounded, slightly narrow with small apical tuft of longer hairs. Notum shining.

Chaetotaxy: Two ors, two ori (sometimes three on one side). Ocellar and postvertical setae subequal to fronto-orbitals. Four dorsocentral setae, strongly decreasing in length anteriorly. Four rows of acrostichal setulae.

Coloration: (Fig. 15) Setae dark brown. Head yellow with back of head above foramen, clypeus, ocellar tubercle and posterolateral margin of frons (not reaching setae) dark brown; posterior margin of eye with very narrow yellow line; vertex behind tubercle narrowly light brown. Scutum dark brown with complete lateral yellow stripe excluding spot on postpronotum; dark scutal spot sometimes with narrower, fainter connection to scutellum, and posterolateral margin with yellow notch in front of posterior dorsocentral and intra-alar setae that may surround setal bases. Lateral dark brown spot on scutellum sometimes vestigial. Mediotergite dark brown, anatergite yellow with anteroventral region brown, and katatergite yellow with posterior margin brown. Pleuron mostly yellow; anepisternum with small weak anteroventral spot that may sometimes be more distinct and circular; anepimeron with limited brown anterior mottling; meron brown ventrally; katepisternum with brown ventral region not reaching base of seta. Calypter margin and hairs light brown. Haltere yellow. Legs yellow with coxae narrowly brown basally, tarsi brownish, and tibiae light brown with base paler, with anterior tibiae almost yellow and hind tibia darker. Abdominal tergites brown with wide lateral yellow stripe partially visible dorsally; brown stripe narrowest on tergite 5; epandrium brown. Pigment darker and more distinct in female.

Genitalia: (Figs. 90–93) Surstylus with two spines. Distal section of ejaculatory duct swollen and pigmented. Phallosorus with narrow venter and long, dark dorsal plate. Basiphallus plate left lateral to dorsal, base relatively

wide and pointed, and left distal corner lightly sclerotized and produced to a point past paraphallus. Paraphallus very small, rod-like. Hypophallus rod-like with apical hairs. Mesophallus short, dark and with anterioventrally produced carina; distiphallus length twice width, slightly compressed dorsoventrally, with complete, broadly open ventral suture, apparently hollow with few medially directed spinules emerging from inner-distal margin laterally. Ejaculatory apodeme narrow, small, barely widened to pale apex; sperm pump with sclerotized venter.

Comments. *Liriomyza carphephori* is a relatively pale species, with the frons around the vertical setae, the anepisternum (faded brownish spot), the posterolateral region of the scutum and the femora being yellow. There are also four strong fronto-orbitals and four rows of acrostichal setulae on a shining scutum. The phallus is most diagnostic however: the paraphalli are small, the basiphallus is downturned with a relatively strong distolateral process, the mesophallus is very short with a large ventral carina, the distiphallus is cylindrical and broadly split ventrally, and the distiphallus is empty—that is, there are no internal structures, including the short fringed tubules typical of most *Liriomyza*.

This is the first record of any agromyzid feeding on *Carphephorus*. In North Carolina, TSF has rarely found mines of *Liriomyza carphephori* on *Bidens*, whereas they are abundant on *Carphephorus* from May through midsummer where this plant occurs. In New England, CSE has found larvae on *B. frondosa* in July as well as in early October after the leaves have turned entirely red; larvae were found on *Mikania scandens* in August. Contorted mines in the apices of *Ageratina altissima* (L.) R.M. King & H. Rob. leaves likely also represent *L. carphephori*; CSE has found occupied examples in Ohio in mid-September.

***Liriomyza helianthi* Spencer**

(Figs. 17–18, 44)

Material examined. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 1.v.2017, em. 22–24.v.2017, T.S. Feldman, ex *Chrysogonum virginianum*, #CSE3705, CNC939767–939771 (2♂ 3♀); same collection, em. 1.ix–15.x.2017, #CSE4351, CNC939781 (1♀ [very poor condition]).

Tentatively identified material. NORTH CAROLINA: Durham Co., Durham, Leigh Farm Park, 10.vi.2016, em. 30.vi.2016, T.S. Feldman, ex *Chrysogonum virginianum*, #CSE2676, CNC654290 (1♀).

Hosts. Asteraceae: *Ambrosia psilostachya* DC., *Artemisia biennis* Willd., **Chrysogonum virginianum* L., *Helianthus annuus* L., *Xanthium strumarium* L.; Brassicaceae: “*Nasturtium*” (Spencer & Steyskal 1986; Lonsdale 2011, 2017).

Leaf mine. (Fig. 44) Upper surface; long, narrow, entirely linear; whitish, with black frass along the sides in strips, beaded strips, and occasionally discrete grains.

Puparium. (Fig. 17) Yellow; formed outside the mine.

Distribution. USA: CA, CO, MD, *NC, NM, OR, VA, WA; Canada: AB, BC, MB, NB, NS, ON, QC, SK (Lonsdale 2017).

Comments. This is the first record of any agromyzid from *Chrysogonum* L.

***Liriomyza polygalivora* spec. nov.**

(Figs. 19–20, 45–46, 94–97)

Holotype. NORTH CAROLINA: Orange Co., Duke forest, Korstian Division, Wooden Bridge Road, 27.vi.2016, em. 10–17.vii.2016, T.S. Feldman, ex *Polygala verticillata*, #CSE2732, CNC654307 (1♂).

Paratypes. NORTH CAROLINA: same collection as holotype, CNC654308–654314 (3♂ 4♀).

Etymology. The specific epithet refers to the host plant, *Polygala* L.

Host. Polygalaceae: *Polygala verticillata* L.

Leaf mine. (Figs. 45–46) At least initially, a whitish, linear mine on the upper leaf surface, with black frass in strips and beaded strips along the sides. Ultimately the mine may be contorted to form a secondary blotch that occupies the entire leaf and is largely full-depth; some frass in these mines is deposited in irregular lumps.

Puparium. (Fig. 20) Yellow to orange-yellow; formed outside the mine.

Distribution. USA: NC.

Adult description. Wing length 1.2–1.4mm (♂), 1.2–1.5mm (♀). Length of ultimate section of vein M₄ divided by penultimate section: 3.0–3.5. Costa extending to M₁. Eye height divided by gena height: 5.8–5.9. First flagellomere small, rounded. Arista pubescent. Notum almost shining.

Chaetotaxy: Two ors, usually two ori; anterior ori present or absent on one or both sides, setula-like to 2/3 length of posterior ori. Ocellar and postvertical setae subequal to fronto-orbitals. Four dorsocentral setae decreasing in length anteriorly, with third seta less than half length of second seta and fourth seta 2/3 length of third seta. Four rows of acrostichal setulae (sparse past second dorsocentral).

Coloration: (Fig. 19) Head yellow with back of head, posterolateral corner of frons to base of inner vertical seta, ocellar tubercle and clypeus dark brown; orbital plate with brownish-gray line along eye that is thicker lateral to ors and may extend to reach base of fronto-orbitals; first flagellomere darker yellow. Scutum dark brown with complete lateral yellow stripe excluding spot on postpronotum. Scutellum dark brown laterally. Mediotergite dark brown, anatergite brownish with anteroventral region darker, katatergite yellow with posteroventral corner brown. Pleuron mostly yellow; anepisternum with large oblique anteroventral stripe that narrows posteriorly and brown medial line along posterior suture; anepisternum with limited brown mottling; meron brown with dorsum yellow; katepisternum with large dark brown ventral spot that does not reach level of seta. Calypter margin gray, hairs brown. Haltere yellow. Legs yellow with base of coxae narrowly brown and tibiae and tarsi brown. Abdominal tergites brown with lateral margin yellow; epandrium and surstylus dark brown.

Genitalia: (Figs. 94–97) Surstylus with two spines. Phalophorus very narrow ventrally. Basiphallus plate irregular in outline, left lateral to dorsal, with narrow sclerotized strip along left distal margin. Hypophallus rod-like with apical hairs. Paraphallus narrow, short, rod-like. Mesophallus cylindrical, more heavily sclerotized laterally, fused to distiphallus and with complete ventral suture, angled dorsally. Distiphallus cup-shaped, wider than long, wider than mesophallus, distal margin dark ventrally and laterally, almost entirely concealing short, paired fringed tubules. Distal section of ejaculatory duct swollen and pigmented. Ejaculatory apodeme large with base barely wider than narrow stem; sperm pump with transverse sclerotized plate ventrally.

Comments. The new species differs from most congeners in having yellow femora and a narrow brown line along the dorsal eye margin on the orbital plate. The genitalia are similar to a number of species, including *L. brassicae* (Riley) (which sometimes also has a narrow brown orbital stripe (Lonsdale 2017: Figs. 225, 226)), but in *L. polygalivora* there are two surstylus spines, the mesophallus is dark (cf. *L. helianthi* Spencer), thick (not slender, cf. *L. conclavis* Lonsdale (Lonsdale 2011: Figs. 74, 75), *L. asclepiadis* Spencer (Lonsdale 2017: Figs. 217, 218)) and widest subapically, and the distiphallus is angled dorsally.

The only agromyzid previously recorded from *Polygala* is the European *Liriomyza polygalae* Hering, which likewise forms a linear-blotch mine.

***Liriomyza schmidti* (Aldrich)**

(Figs. 21–22, 47–48)

Material examined. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 14–17.viii.2017, em. ~31.viii.2017, T.S. Feldman, ex *Gelsemium sempervirens*, #CSE4203, CNC939739–939742 (2♂ 2♀); 21.viii.2017, em. 8.ix.2017, T.S. Feldman, ex *Gelsemium sempervirens*, #CSE4241, CNC939748, CNC939749 (2♂).

Hosts. Aristolochiaceae: *Aristolochia* L. (Spencer 1990), Fabaceae: *Albizia lebeck* (L.) Benth., *Bauhinia purpurea* L., *Mucuna pruriens* (L.) DC.; *Gelsemiaceae: *Gelsemium sempervirens* (L.) W.T. Aiton; Nyctaginaceae: *Bougainvillea spectabilis* Willd.; Passifloraceae: *Passiflora caerulea* L.; Smilacaceae: *Smilax* L. (not reared, but puparia examined) (Stegmaier 1966; Spencer & Stegmaier 1973). Larvae or empty mines presumed to represent this species have also been found in North Carolina on *Anacardiaceae: *Toxicodendron vernix* (L.) Kuntze; in Texas on *Passiflora lutea* L. (Hildebrandt 2016); and in Florida on *Alismataceae: *Sagittaria lancifolia* L.; Apocynaceae: *Vinca minor* L., **Wrightia antidysenterica* (L.) R.Br.; *Araliaceae: *Schefflera arboricola* (Hayata) Merr.; Euphorbiaceae: *Acalypha hispida* Burm. f., *Breynia disticha* J.R. Forst. & G. Forst.; Fabaceae: *Bauhinia jenningsii* P. Wilson, *Crotalaria lanceolata* E. Mey., **Dalbergia ecastaphyllum* (L.) Taubert, *Erythrina herbacea* L., **Senna quinqueangulata* (Rich.) H.S. Irwin & Barneby; Nyctaginaceae: **Pisonia aculeata* L.; Passifloraceae: *Passiflora biflora* Lam.; *Rhamnaceae: *Colubrina elliptica* (Sw.) Briz. & Stern; Rubiaceae: *Chiococca alba* (L.)

Hitchc., *Hamelia patens* Jacq.; *Sapotaceae: *Sideroxylon foetidissimum* Jacq.; *Vitaceae: *Cissus verticillata* (L.) Nicolson & Jarvis; and *Zamiaceae: *Zamia pumila* L. (Stegmaier 1966; Spencer & Stegmaier 1973; new records from mines collected or photographed by CSE and TSF). Lower surface mines photographed in Miami, Florida by E. LoPresti (*in litt.*) on *Annona glabra* L. (Annonaceae) and *Passiflora pallida* L. also appear to represent *L. schmidti*.

Leaf mine. (Figs. 47–48) A silvery, epidermal, irregular serpentine mine on the upper leaf surface (Spencer & Stegmaier 1973).

Puparium. (Fig. 22) Brown; formed outside the mine (Spencer & Stegmaier 1973).

Distribution. USA: FL, *NC; Bahamas; Costa Rica; Jamaica (Spencer & Stegmaier 1973). We have found likely *L. schmidti* mines on *Gelsemium sempervirens* in South Carolina, and Hildebrandt (2016) photographed mines in Texas as noted above.

Comments. The characteristic epidermal mine of *Liriomyza schmidti* is highly unusual for North American Agromyzidae; the only similar agromyzid mine in this region known to us is that of *Phytomyza opacae* Kulp on *Ilex* spp. (Aquifoliaceae), which differs in having the puparium formed internally. Outside of the USA, this polyphagous species is also recorded from Apocynaceae (*Rauwolfia*), Basellaceae (*Anredera*), Bignoniaceae (*Clytostoma*, *Tabebuia*), Convolvulaceae (*Convolvulus*, *Ipomoea*), Dioscoreaceae (*Dioscorea*), Euphorbiaceae (*Manihot*), Fabaceae (*Erythrina*, *Gliricidia*), Petiveriaceae (*Rivina*), Phyllanthaceae (*Phyllanthus*), Pittosporaceae (*Pittosporum*), Solanaceae (*Brunfelsia*), Thymelaeaceae (*Daphnopsis*), and Zygophyllaceae (*Bulnesia*) (Benavent-Corai *et al.* 2005).

***Liriomyza triodanidis* spec. nov.**

(Figs. 23–24, 49, 98–101)

Holotype. NORTH CAROLINA: Scotland, Laurinburg, St. Andrews University, 4.v.2016, em. 23.v.2016, T.S. Feldman, ex *Triodanis biflora*, #CSE2491, CNC653945 (1♂).

Additional material examined. NORTH CAROLINA: same collection as holotype, CNC653944 (1 undeveloped ♀).

Etymology. The specific epithet refers to the host plant, *Triodanis* Raf. ex Greene.

Host. Campanulaceae: *Triodanis biflora* (Ruiz & Pav.) Greene.

Larval mine. (Fig. 49) Whitish, linear, sometimes contorted to form a secondary blotch. Mines are largely on stems, continuing onto the lower surfaces of leaves; the appearance on the upper leaf surface varies from a slight discoloration to conspicuous whitish mottling, depending on the thickness of the leaf and depth of the mine. Some mines clearly terminate on the leaves but in the mines we examined it was not evident where oviposition occurred. The dark green frass is in grains and beaded strips.

Puparium. (Fig. 24) Yellow; formed outside the mine.

Distribution. USA: NC.

Adult description. Wing length 1.5mm (♂). Female undeveloped. Length of ultimate section of vein M_4 divided by penultimate section: 2.5. Costa extending to M_1 . Eye height divided by gena height: 3.3. First flagellomere small, rounded, with some longer apical hairs. Arista pubescent. Frons slightly projecting anteriorly. Cheek narrow, but well-defined. Notum pruinose.

Chaetotaxy: Two ori, two ors. Ocellar and postvertical (thinner) setae subequal to ors. Four dorsocentral setae, decreasing in length anteriorly, with anterior two pairs not much larger than setulae. Two rows of acrostichal setulae. Intra-alar setulae absent.

Coloration: (Fig. 23) Setae dark brown. Head yellow with posterolateral corner of frons to base of outer vertical seta, back of head excluding venter, small triangular spot enclosing ocellar tubercle, posterior margin of frons and clypeus dark brown; first flagellomere with orange tint. Scutum dark brown with complete lateral yellow stripe excluding spot on postpronotum and in posterolateral corner; notum slightly pruinose with faint silvery shine. Scutellum dark brown laterally. Mediotergite dark brown, anatergite brown, katatergite yellow with posteroventral region brown. Pleuron mostly yellow; anepisternum with short oblique anteroventral brown stripe (narrower posteriorly), anepimeron with posterior margin and anterior mottling brown; meron brown with dorsum yellow; katepisternum with large ventral spot not reaching level of seta and with minute spot posterior to seta.

Calypter margin and hairs light brown. Haltere yellow. Legs yellow with base of fore coxa brown, mid coxa mottled, hind coxa brownish with basal half darker, tibiae brown with anterior leg paler and posterior leg darker, and tarsi brown. Abdomen yellow with wide, ill-defined spot on tergite 1, tergite 2 with one pair of wide spots, tergites 3–5 with dorsal stripe that narrows posteriorly, and epandrium dark brown.

Genitalia: (Figs. 98–101) Surstylus narrow with one subapical spine. Phallosphorus shorter ventrally. Basiphallus with long, narrow left lateral sclerotization widening to dorsoapical plate. Apical section of ejaculatory duct dark and swollen, ovate. Paraphallus narrow, rod-like. Hypophallus curved, narrow, with apical hairs, Mesophallus wider than long, dark, with laterobasal emargination, with complete ventral suture, fused to distiphallus and with elongate ventral bands continuing onto distiphallus bowl. Distiphallus slightly asymmetrical; with broad, shallow, dorsally angled basal bowl with swollen left half, with small bumps on inner surface of left side, pointed extension from dorsomedial margin, and short grooved ventromedial plate (left side only); tubules of distiphallus fused along midline to form single wide tube, slightly curved to venter and angled to right. Ejaculatory apodeme large, dark, well-developed with base narrow; blade paler distally, partially striated. Sperm pump sclerotized ventrally onto base of duct, laterally with thick dark sclerotized margins.

Comments. As with most *Liriomyza*, some external features are useful for diagnosis (posterolateral corner of frons dark to outer vertical, two rows of acrostichal setulae, intra-alar setulae absent, scutum faintly silvery pruinose), but the male genitalia are essential for confident identification: the basal bowl of the distiphallus is asymmetrical, well-defined and angled dorsally; the apical tubules are shallowly sinuate, fused, as long as the basiphallus and pointed apically.

No agromyzid has previously been recorded from *Triodanis*.

***Phytomyza plantaginis* Robineau-Desvoidy**

(Figs. 25, 40)

Material examined. NORTH CAROLINA: Scotland Co., Laurinburg, St. Andrews University, 2.v.2017, em. 18.v.2017, T.S. Feldman, ex *Plantago wrightiana*, #CSE3686, CNC939743 (1♀).

Hosts. Plantaginaceae: *Plantago lanceolata* L., *P. major* L. (Spencer 1969), *P. *wrightiana* Decne. TSF has found leaf mines consistent with *Phytomyza plantaginis* on *Plantago rugelii* Decne.

Leaf mine. (Fig. 40) Long, narrow, white, linear; frass in large, widely spaced grains.

Puparium. Whitish; formed within the leaf, with the anterior spiracles projecting through the epidermis.

Distribution. Widespread through most of the USA; Canada: AB (Sehgal 1971), ON, QC (Spencer 1969); Europe; Japan; Australia; New Zealand (Spencer & Steyskal 1986).

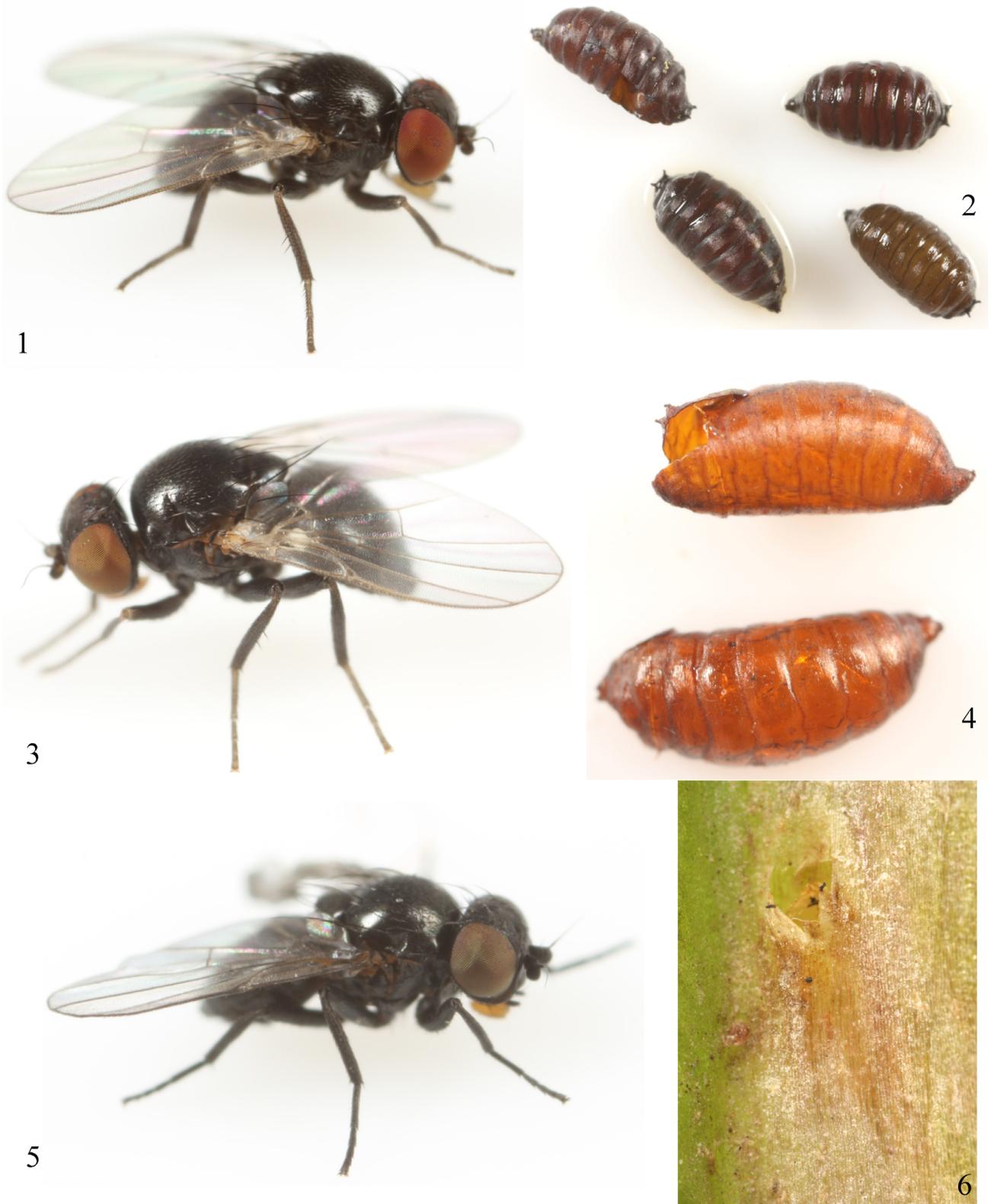
Comments. Although females of *Phytomyza plantaginis* cannot always be distinguished with certainty from those of the European *P. griffithsi* Spencer, the mine of that species is clearly different, consisting of numerous branches radiating from the petiole (Ellis 2018).

Acknowledgments

M. Locke (CNC) is thanked for her efforts in preparing the material examined. We thank Sara Stefan of the Piedmont Wildlife Center for access to Leigh Farm Park, Sara Childs for providing information about the Duke Forest collection site, St. Andrews University for research support, and Mr. Rooney Coffman at St. Andrews for help with logistics. We also thank Roger Hammer for identifying some of the Florida host plants of *Liriomyza schmidti* (several of them exotic ornamentals in his yard in Homestead), Eric LoPresti and Katherine Toll (Department of Plant Biology, Michigan State University) for providing photographs and specimens documenting additional hosts for *L. schmidti*, and Michael von Tschirnhaus (University of Bielefeld, Germany) and an anonymous reviewer for feedback on the manuscript.

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FIGURES 1–6. **FIGURES 1–2.** *Agromyza arundinariae* spec. nov.; **1:** male; **2:** puparia. **FIGURES 3–4:** *Agromyza indistincta* spec. nov.; **3:** female; **4:** empty puparia. **FIGURE 5:** *Ophiomyia beckeri* (Hendel), male. **FIGURE 6:** *Ophiomyia* sp. 2, empty puparium in leaf midrib.



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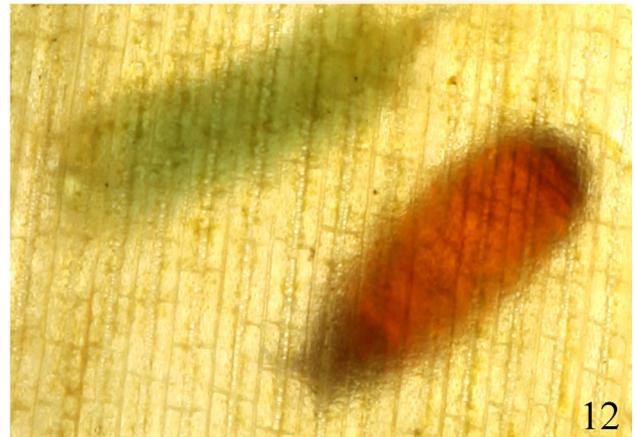
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FIGURES 7–14. FIGURES 7–8. *Calycomyza chrysopsidis* spec. nov.; 7: male; 8: empty puparium in opened mine. FIGURES 9–10: *Cerodontha (Butomomyza) enigma* spec. nov.; 9: male; 10: empty puparium. FIGURES 11–12: *Cerodontha (Poemyza) arundinariella* spec. nov.; 11: male; 12: larva and puparium in mine. FIGURES 13–14. *Cerodontha (Poemyza) saintandrewsensis* spec. nov.; 13: male; 14: empty puparium.



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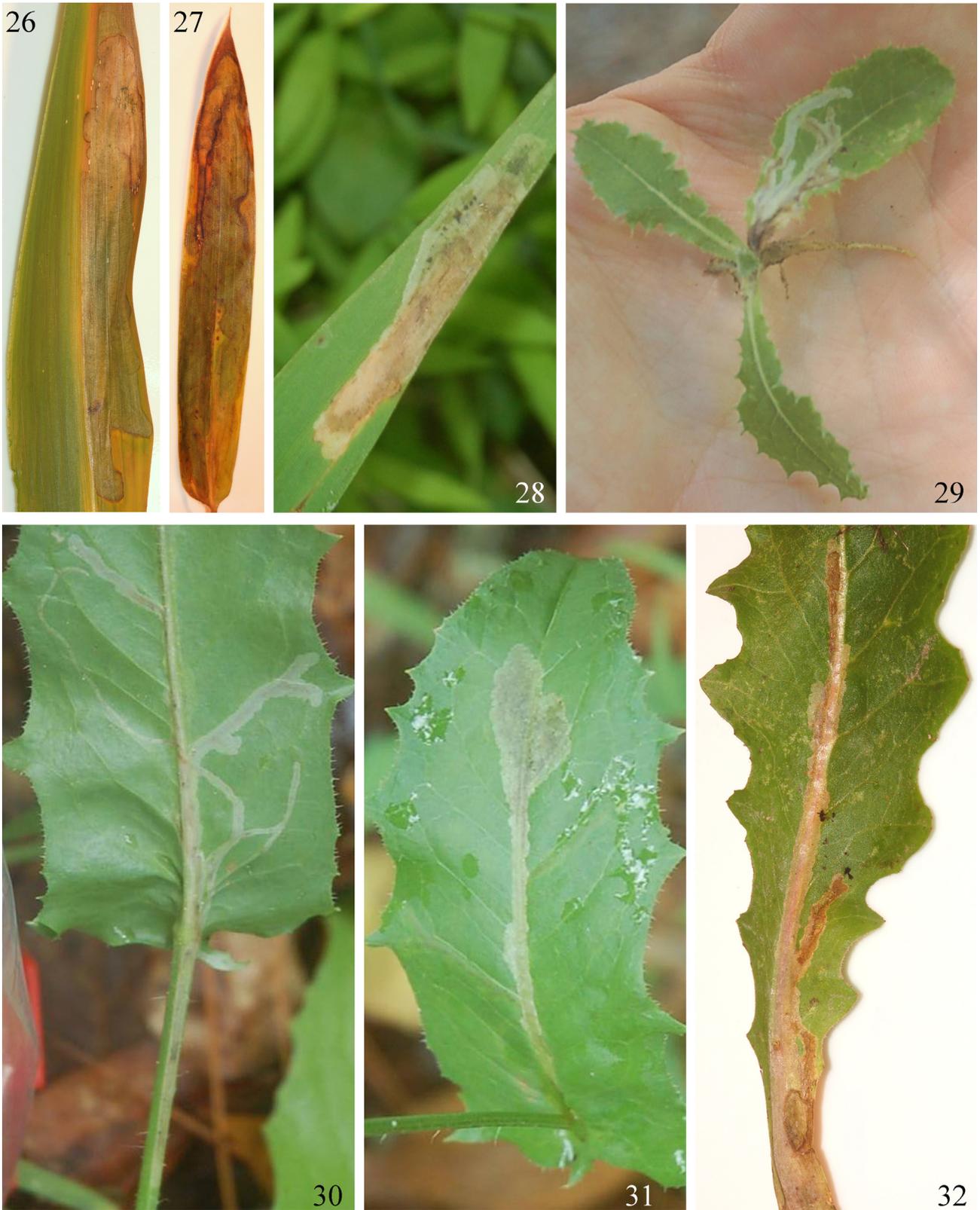


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FIGURES 15–20. FIGURES 15–16: *Liriomyza carphophori* spec. nov.; 15: male; 16: puparia. FIGURES 17–18: *Liriomyza helianthi* Spencer; 17: puparia; 18: male. FIGURES 19–20: *Liriomyza polygalivora* spec. nov.; 19: female; 20: puparia.



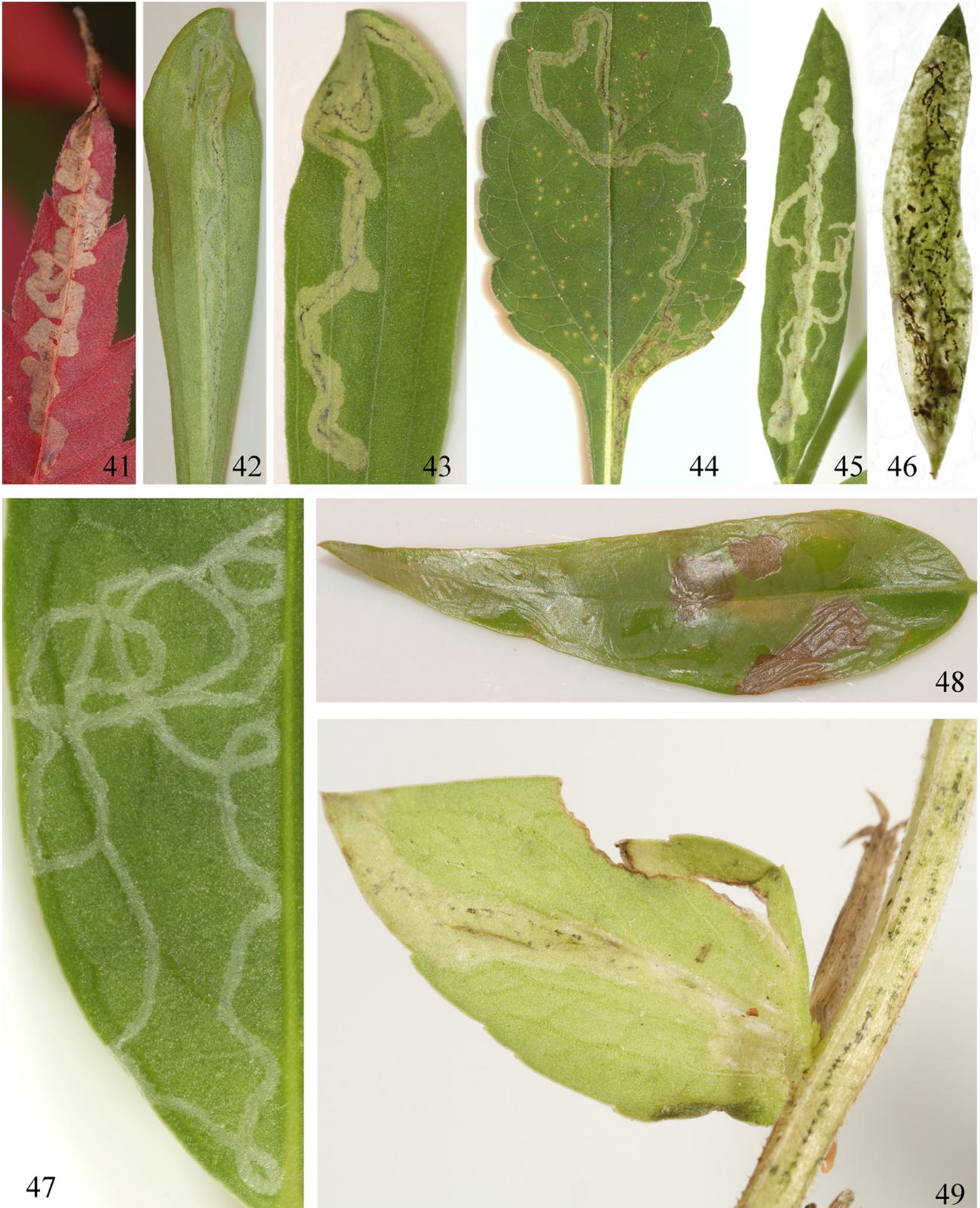
FIGURES 21–25. FIGURES 21–22. *Liriomyza schmidti* (Aldrich); 21: male; 22: empty puparium. FIGURES 23–24: *Liriomyza triodanidis* spec. nov.; 23: male; 24: puparium. FIGURE 25: *Phytomyza plantaginis* Robineau-Desvoidy, female.



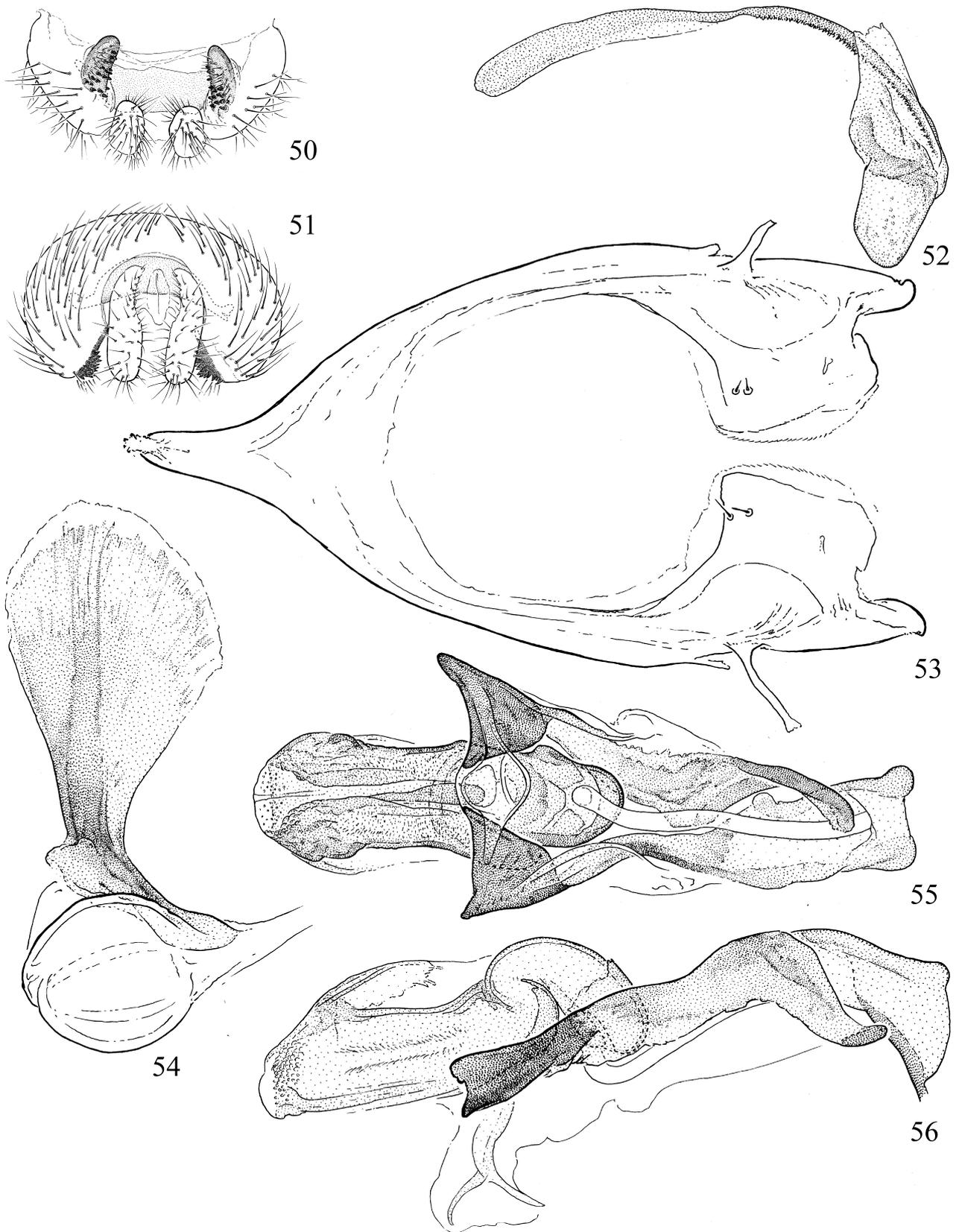
FIGURES 26–32. leaf mines; **26:** *Agromyza arundinariae* **spec. nov.** on *Arundinaria tecta*; **27:** same; **28:** *A. indistincta* **spec. nov.** on *Dichanthelium*; **29:** *Ophiomyia beckeri* (Hendel) on *Sonchus*; **30:** *Ophiomyia* sp. 1 on *Hypochaeris chillensis*, lower leaf surface; **31:** same, upper leaf surface; **32:** *Ophiomyia* sp. 2 on *Pyrrhopappus carolinianus*.



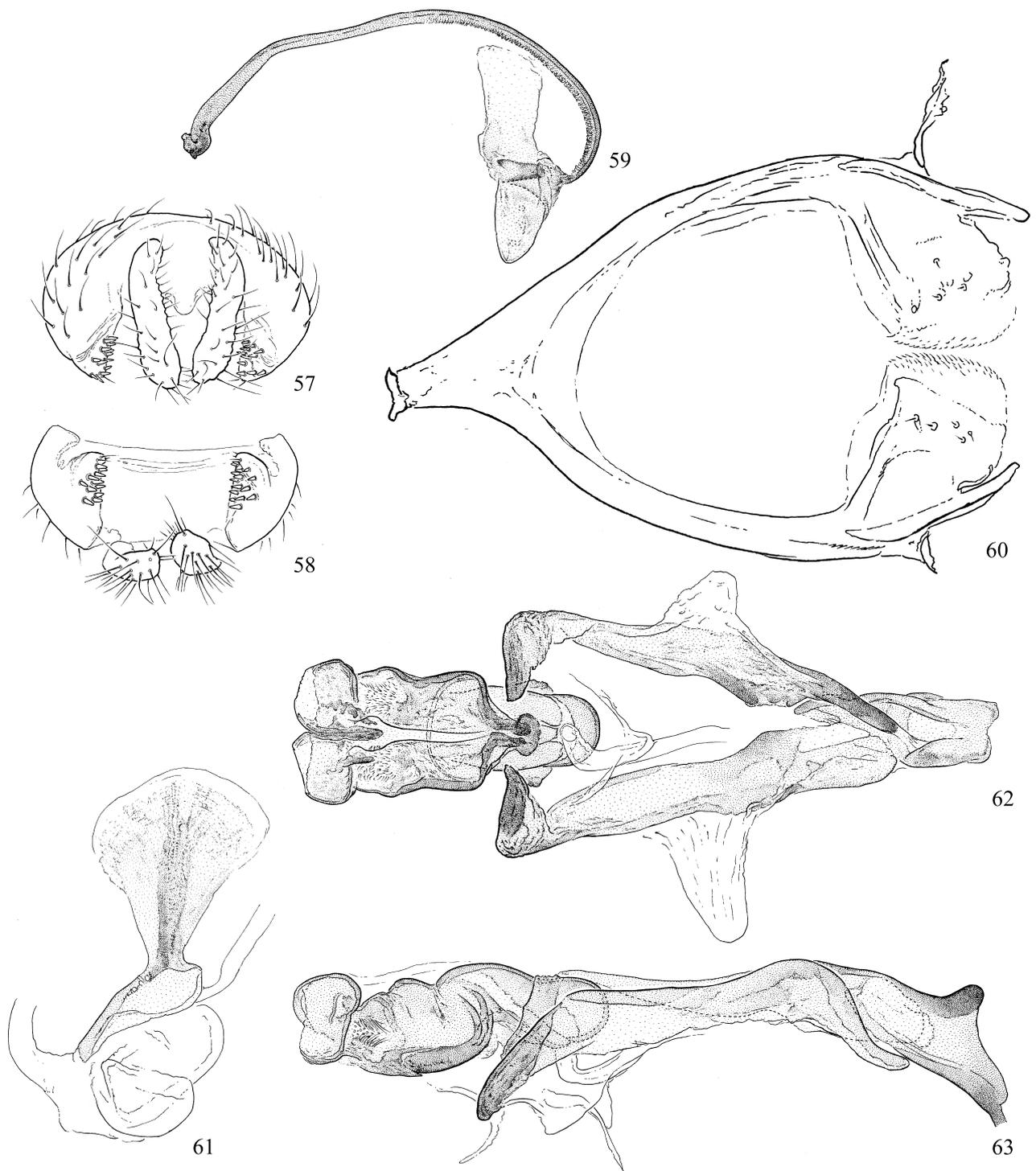
FIGURES 33–40. leaf mines; **33:** *Calycomyza chrysopsidis* **spec. nov.** on *Chrysopsis mariana*, reflected light (puparium at leaf base); **34:** same, transmitted light (puparium at lower right); **35:** *C. novascotiensis* Spencer on *Scutellaria integrifolia*, initial serpentine portion (reflected light); **36:** same, completed mine (transmitted light); **37:** *Cerodontha (Butomomyza) enigma* **spec. nov.** on *Dichanthelium dichotomum*; **38:** *Cerodontha (Poemyza) arundinariella* **spec. nov.** on *Arundinaria tecta* (transmitted light); **39:** *Cerodontha (Poemyza) saintandrewsensis* **spec. nov.** on *Arundinaria tecta*; **40:** *Phytomyza plantaginis* Robineau-Desvoidy on *Plantago wrightiana* (transmitted light; puparium in middle of leaf).



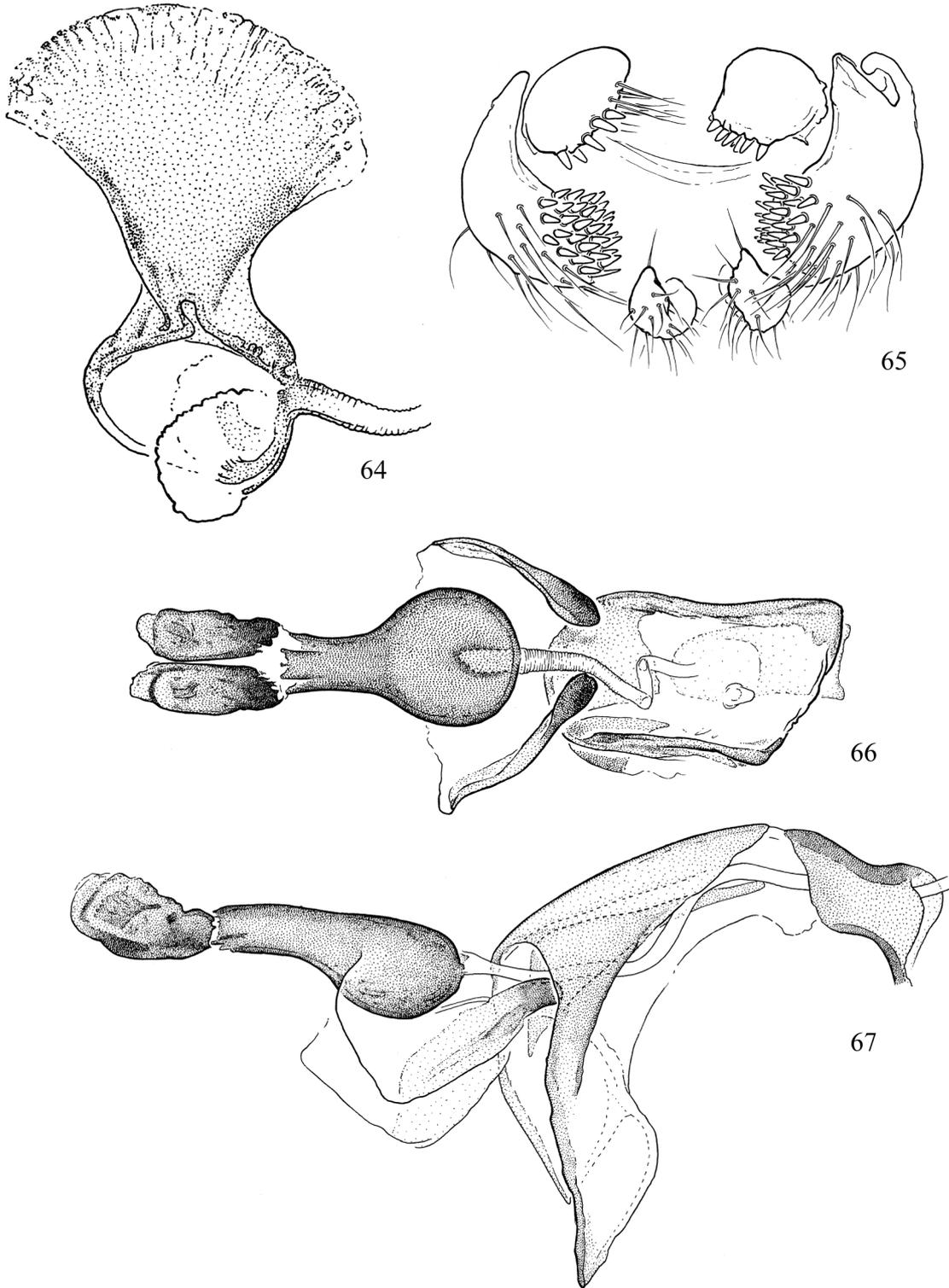
FIGURES 41–49. leaf mines; **41:** *Liriomyza carphophori* **spec. nov.** on *Bidens frondosa*; **42:** same, on *Carphephorus bellidifolius*, lower surface; **43:** same leaf, showing terminal portion on upper surface; **44:** *L. helianthi* Spencer on *Chrysogonum virginianum*; **45:** *L. polygalivora* **spec. nov.** on *Polygala verticillata*, incomplete mines (reflected light); **46:** same, leaf completely mined (transmitted light); **47:** *L. schmidti* (Aldrich) on *Gelsemium sempervirens*, incomplete mine; **48:** same, mine covering almost entire leaf surface; **49:** *L. triodanidis* **spec. nov.** on *Triodanis biflora*, mine on stem and lower leaf surface.



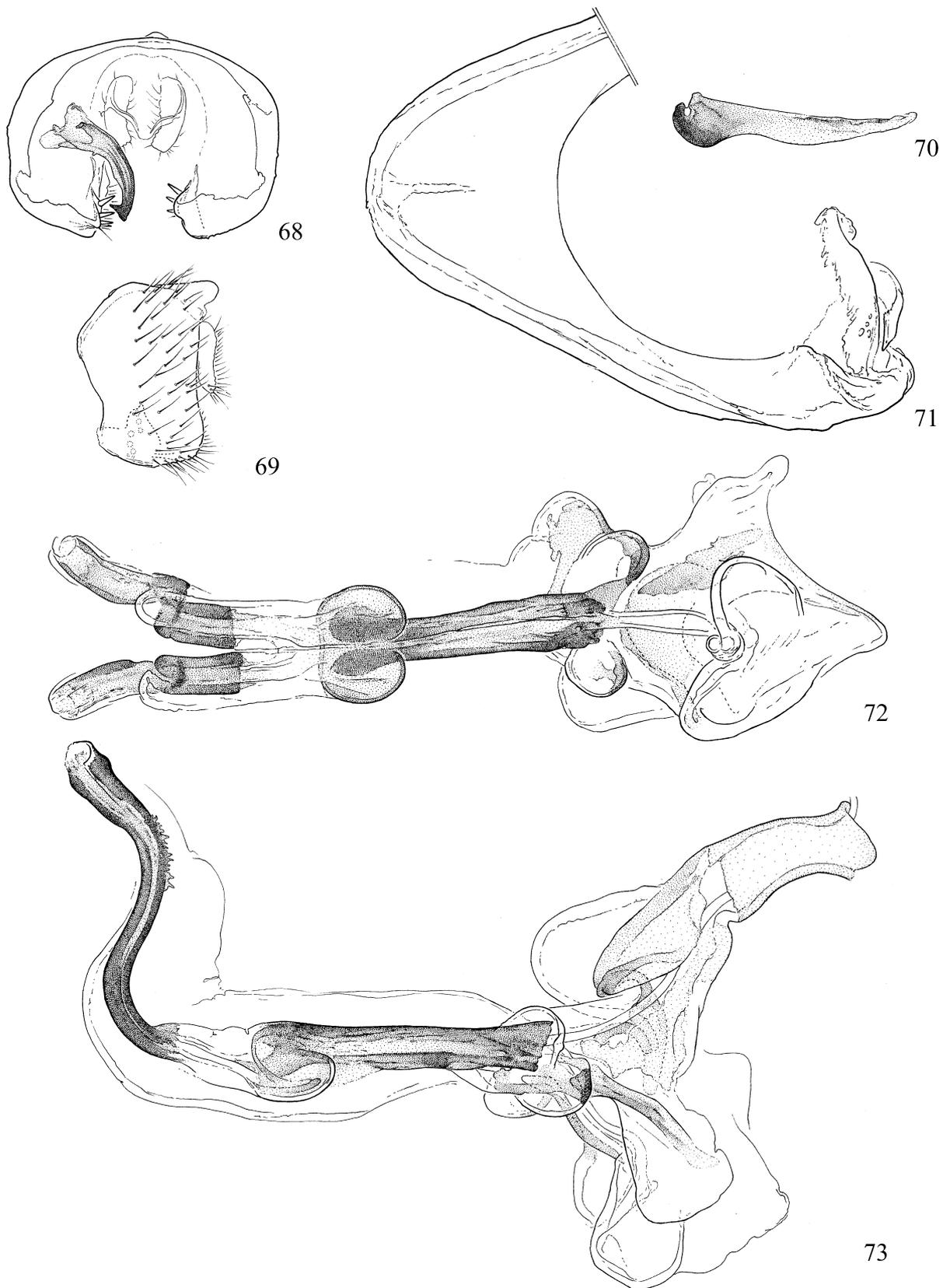
FIGURES 50–56. *Agromyza arundinariae* spec. nov., male genitalia; **50:** external genitalia, ventral; **51:** external genitalia, posterior; **52:** postgonite; **53:** hypandrium; **54:** ejaculatory apodeme; **55:** phallus, ventral; **56:** phallus, left lateral.



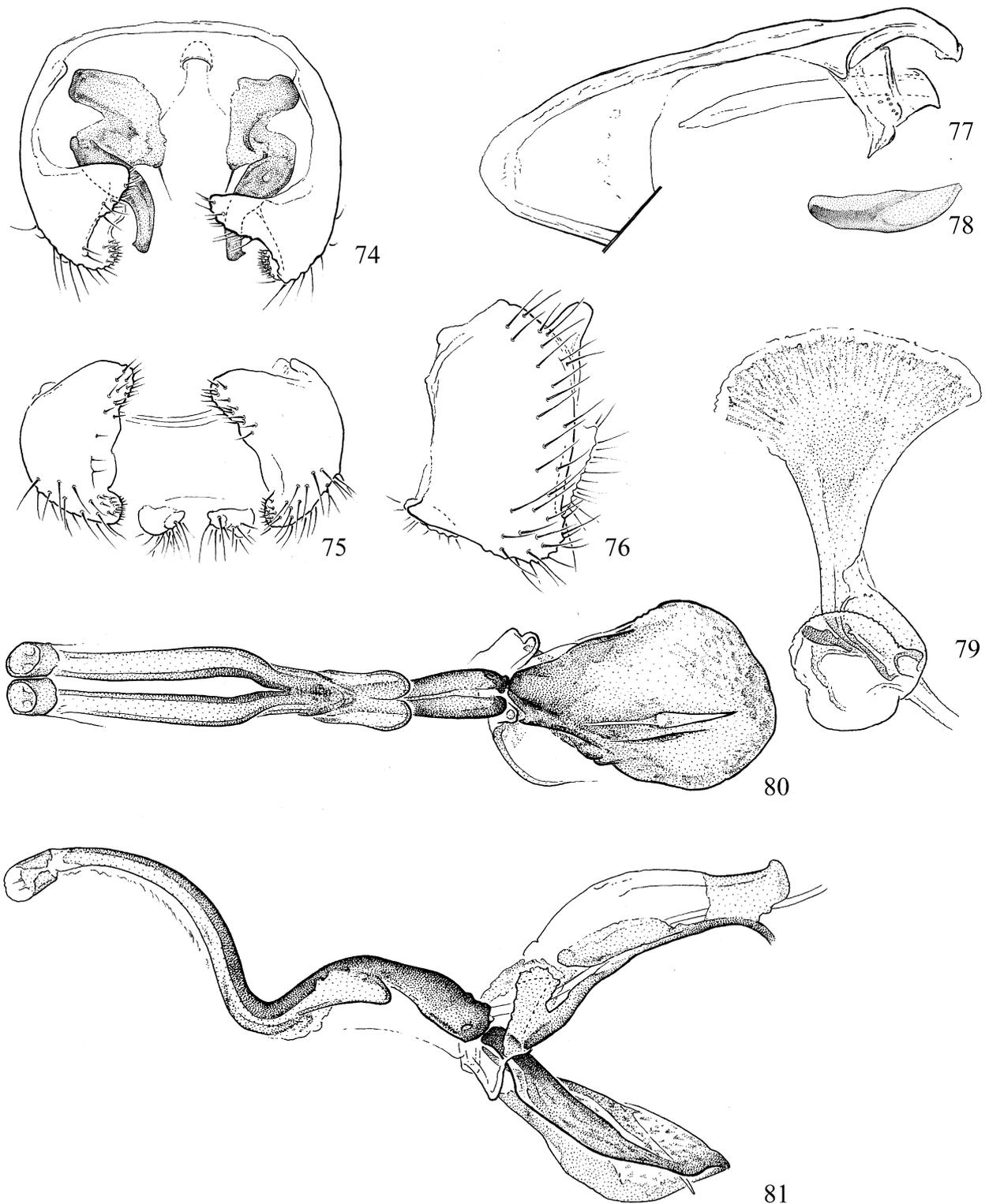
FIGURES 57–63. *Agromyza indistincta* spec. nov., male genitalia; **57:** external genitalia, posterior; **58:** external genitalia, ventral; **59:** postgonite; **60:** hypandrium; **61:** ejaculatory apodeme; **62:** phallus, ventral; **63:** phallus, left lateral.



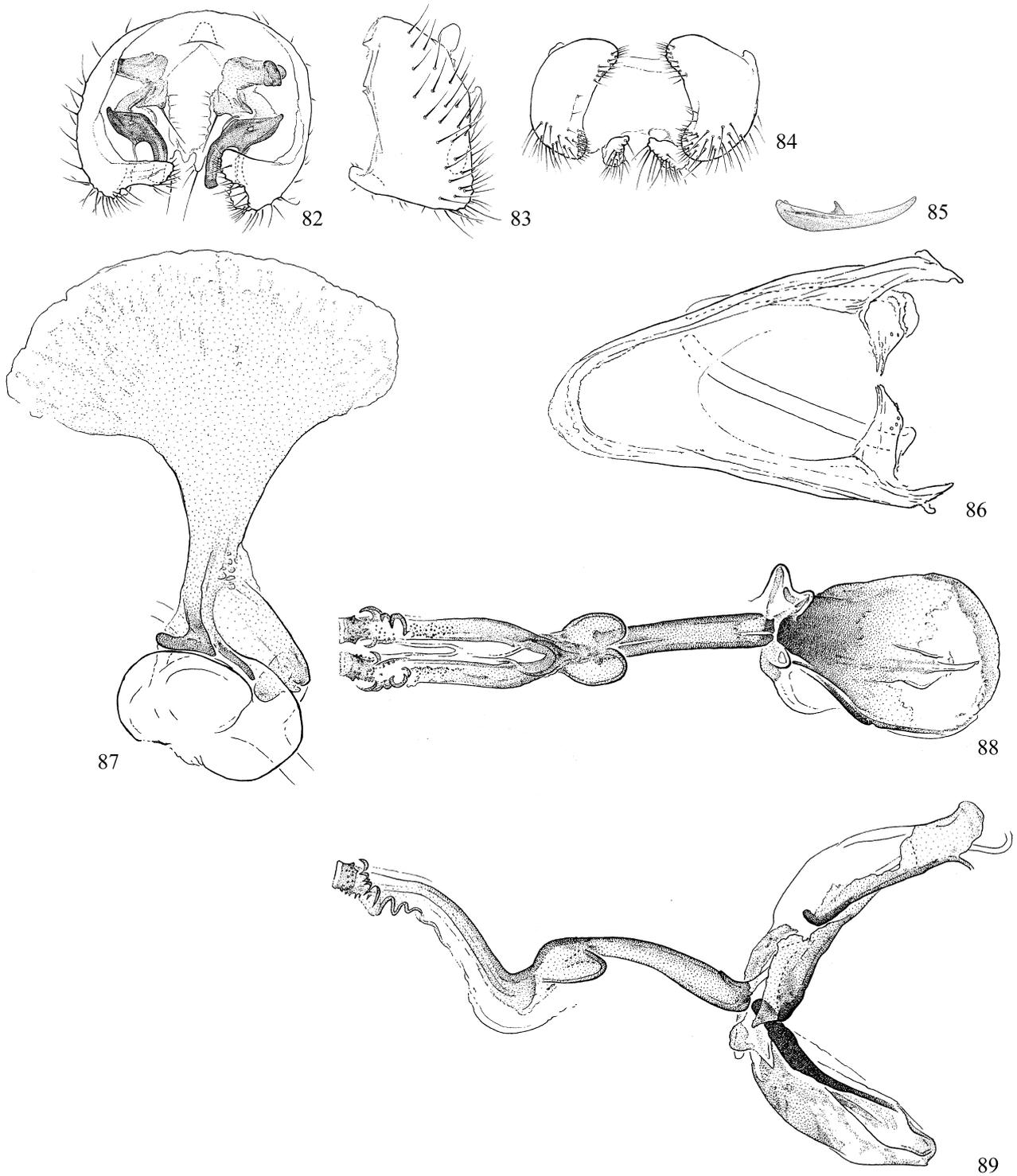
FIGURES 64–67. *Calycomyza chrysopsidis* **spec. nov.**, male genitalia; **64:** ejaculatory apodeme; **65:** external genitalia, ventral; **66:** phallus, ventral; **67:** phallus, left lateral.



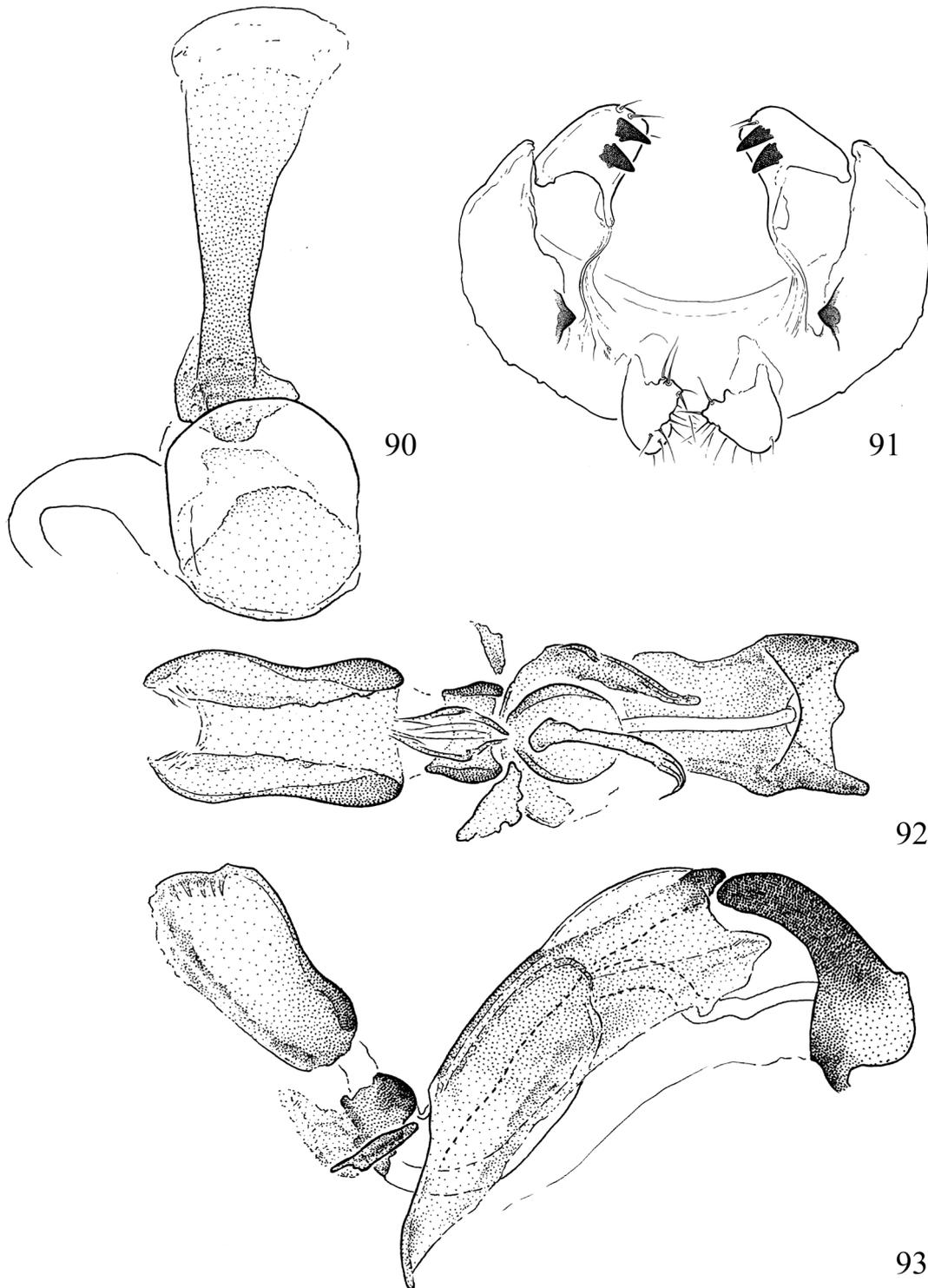
FIGURES 68–73. *Cerodontha (Butomomyza) enigma spec. nov.*, male genitalia; **68:** external genitalia, anterior; **69:** external genitalia, left lateral; **70:** postgonite; **71:** hypandrium; **72:** phallus, ventral; **73:** phallus, left lateral.



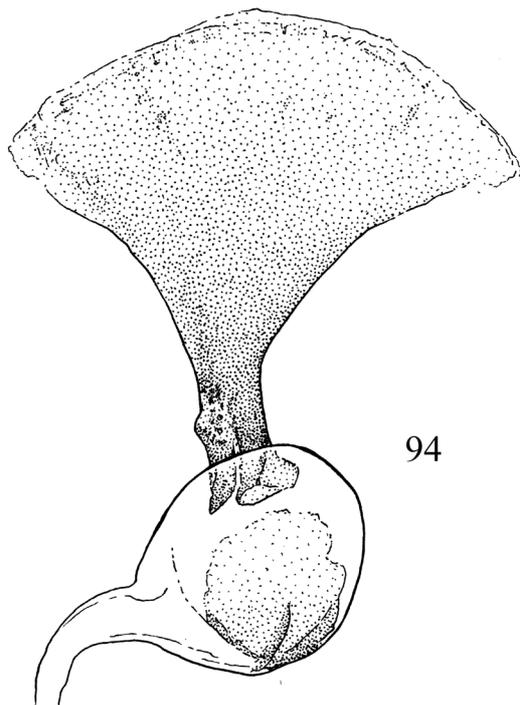
FIGURES 74–81. *Cerodontha (Poemyza) arundinariella* spec. nov., male genitalia; **74:** external genitalia, anterior; **75:** external genitalia, left lateral; **76:** external genitalia, ventral; **77:** postgonite; **78:** hypandrium; **79:** ejaculatory apodeme; **80:** phallus, ventral; **81:** phallus, left lateral.



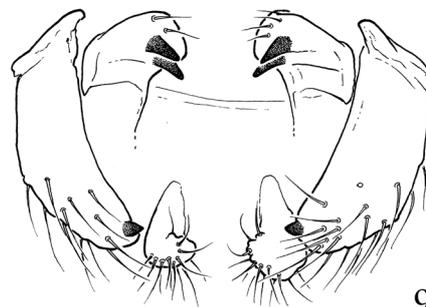
FIGURES 82–89. *Cerodontha (Poemyza) saintandrewsensis* spec. nov., male genitalia; **82:** external genitalia, anterior; **83:** external genitalia, ventral; **84:** external genitalia, left lateral; **85:** hypandrium; **86:** postgonite; **87:** ejaculatory apodeme; **88:** phallus, ventral; **89:** phallus, left lateral.



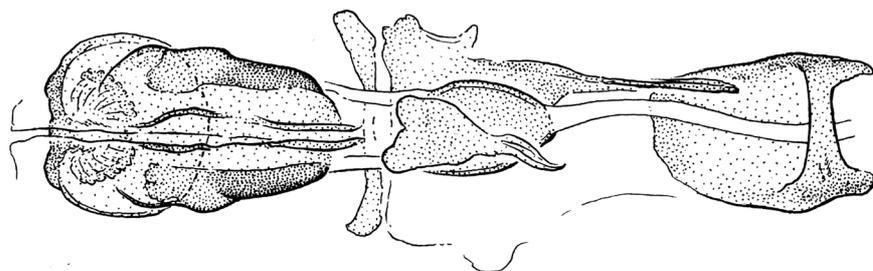
FIGURES 90–93. *Liriomyza carphephori* spec. nov., male genitalia; **90:** ejaculatory apodeme; **91:** external genitalia, ventral; **92:** phallus, ventral; **93:** phallus, left lateral.



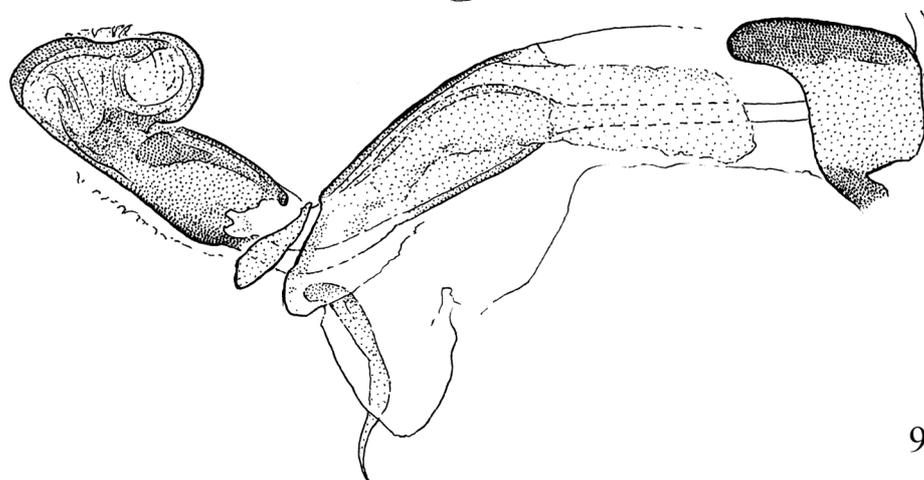
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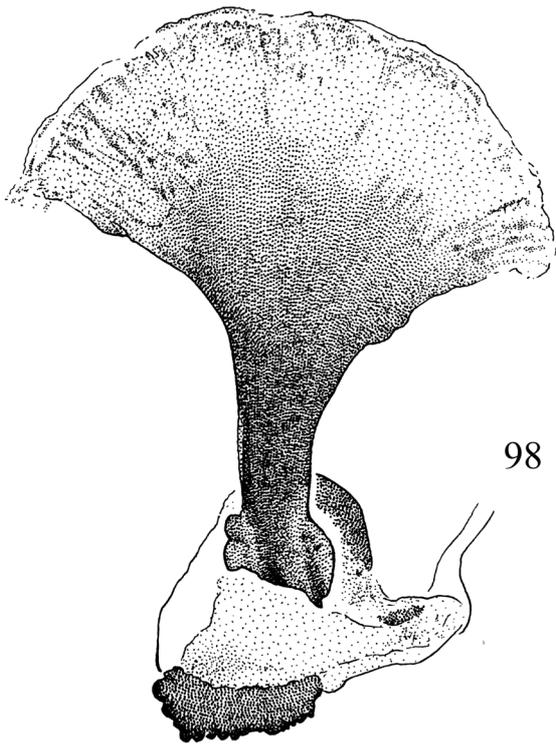


96

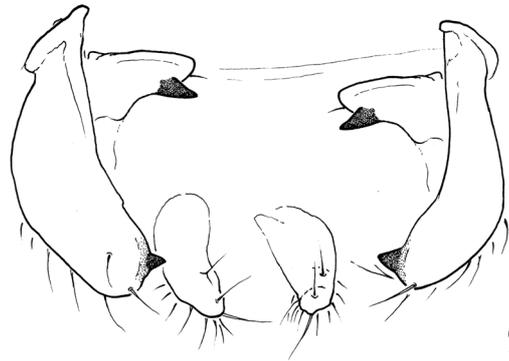


97

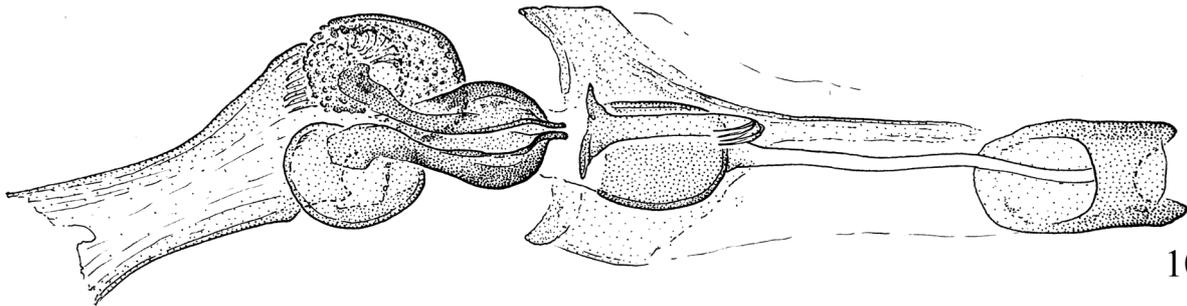
FIGURES 94–97. *Liriomyza polygalivora* spec. nov., male genitalia; **94:** ejaculatory apodeme; **95:** external genitalia, ventral; **96:** phallus, ventral; **97:** phallus, left lateral.



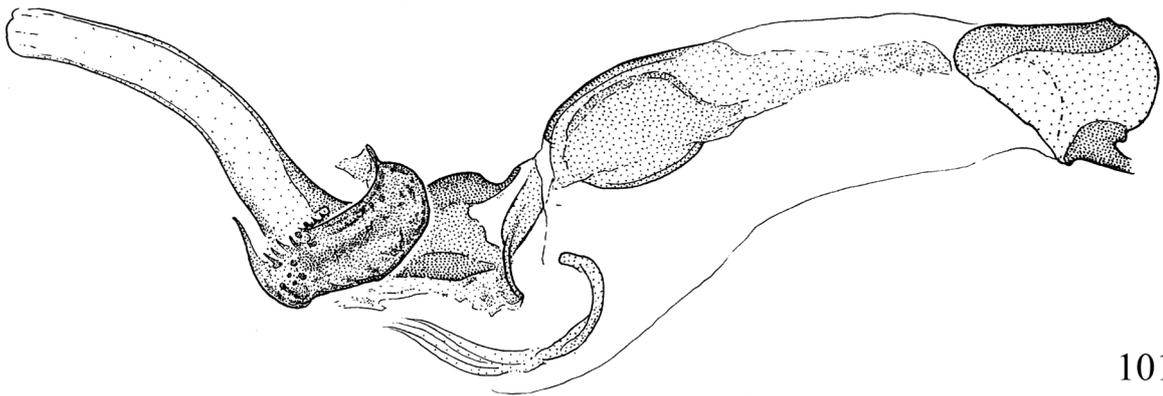
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101

FIGURES 98–101. *Liriomyza triodanidis* spec. nov., male genitalia; **98:** ejaculatory apodeme; **99:** external genitalia, ventral; **100:** phallus, ventral; **101:** phallus, left lateral.